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ECONOMIC BASE STUDY OF THE MOBILE-ALABAMA-COOSA RIVER BASIN

ALABAMA UNIVERSITY, UNIVERSITY

PREPARED FOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
WASHINGTON, D.C.

JUNE 1967

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ECONOMIC BASE STUDY OF THE MOBILE-ALABAMA-COOSA RIVER BASIN

Prepared By The

Bureau Of Business Research
University Of Alabama
University, Alabama

Under Contractual Agreement With

UNITED STATES DEPARTMENT OF THE INTERIOR

FEDERAL WATER POLLUTION CONTROL ADMINISTRATION

JUNE 1967

Contract No. PH 86-65-45

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SCHOOL OF COMMERCE AND BUSINESS ADMINISTRATION

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Mr. C. V. Lyle
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Dear Mr. Lyle:

In accordance with the provisions of Contract Number PH 86-65-45 HEW PH Bureau of Business Services EH, Division of Water Supply and Pollution Control (Region IV) dated February 1, 1965; Supplemental Agreement Contract Number PH 86-65-45, Modification Number 3, U. S. Department of the Interior, Federal Water Pollution Control Administration, dated January 28, 1966, we are pleased to submit our Report of the Economic Base Study for the Mobile-Alabama-Coosa River Basin Study Area.

This Study has developed projections to 1965, 1980 and 2015 of the MAC Study Area's primary economic indicators and basic components of each indicator. These projections may prove useful as general guides to the preparation of plans for comprehensive development of the MAC Study Area's water and related land resources.

We appreciate the opportunity that this project provided to permit us to serve the Federal Departments concerned with this Study.

Sincerely yours,

Henry B. Moore

Henry B. Moore, Director
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Georgia Department of Public Health
Coosa Valley Area Planning and Development Commission

Dr. Paul W. Paustian
Project Director

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AN ECONOMIC BASE STUDY OF THE MOBILE-ALABAMA-COOSA RIVER BASIN

INTRODUCTION

This report presents the results of an Economic Base Study of the Mobile-Alabama-Coosa River Drainage Basins. The total area studied (hereinafter referred to as the MAC Basin area) is included in the Southeastern Comprehensive Water Pollution Control Project, and completes the one remaining river basin economic base study of that project.

One purpose of this study is to project the economic growth and development of the MAC Basin area to 1965 (considered as current), 1980, and 2015, for use in the preparation of plans for the comprehensive development of the MAC Basin area's water and related land resources that will meet emerging needs in a timely and efficient manner. Thus, a major purpose of this economic base study is to provide a framework within which programs and projects for water quality control may be appropriately formulated and evaluated by United States Department of the Interior Federal Water Pollution Control Administration; The U. S. Department of Health, Education, and Welfare, and the U. S. Army Corps of Engineers working with other Federal agencies and State and local governments.

As a means of accomplishing this purpose economic and demographic characteristics, growth rates, and trends are developed through time-series analyses and taken into account in projecting future growth and development patterns for use in planning activities.

Primary economic parameters such as population, labor force, employment, personal income, number of households, and educational levels, (and the components of each indicator), were studied and projected to show expected magnitude and patterns of growth in the MAC Base Study Area during the fifty-year projection period.

The results of this study may be utilized by Federal, State and Local agencies, both public and private, that are engaged in planning and research programs.

CHAPTER I

PURPOSES AND OBJECTIVES OF AN ECONOMIC BASE STUDY FOR THE MOBILE-ALABAMA-COOSA BASIN SUB-AREA OF THE SOUTHEASTERN COMPREHENSIVE WATER POLLUTION CONTROL PROJECT AREA

I. Description of Work

This report describes the work accomplished in developing an economic base study of the MOBILE-ALABAMA-COOSA River Basins subarea (hereinafter referred to as the MAC Basin Area) of the Southeastern Comprehensive Water Pollution Control Project (hereinafter referred to as the SECWPCP area). Generalized economic studies have been completed or are in process of being completed for all basin areas within the SECWPCP area except the MAC Basin area. This study completes the series.

As required by the contract, this MAC Basin area study appropriately recognizes and takes into account areas beyond the project area which may be served by waters of the area (or significantly affect the economic development of the MAC Basin drainage area). The report also (1) characterizes the existing economy of the project area and its sub-areas, (2) indentifies and analyses the economic forces which will influence the future economic changes within the areas, and (3) projects the future economy of the areas. Insofar as practicable, this study has attempted to identify and measure the economic, social, physical, technological, and related elements relevant to economic growth and development within the MAC Basin area. Statistical data reflecting the characteristics, demographic and economic trends, and the bases for projections into the future, and provided on a total MAC Basin area basis, as well as on subarea bases.

All statistical data were collected on a county basis and then aggregated into subareas, and compared with national and regional areas.

II. Purpose

The Federal Water Pollution Control Act required that the Secretary of the United States Department of the Interior (through the Federal Water Pollution Control Administration) develop comprehensive water pollution control programs in cooperation with other

Federal, State, interstate, and local water pollution control agencies for the purpose of eliminating or reducing water pollution in surface and underground sources for all purposes.

A major purpose of this economic base study is to provide a framework within which programs and projects for water quality control may be appropriately formulated and evaluated. It is specifically the purpose of this study to project the growth of the MAC Basin portion of the SECWPCP area and appropriate sub-areas thereof to serve as a guide in the formulation and evaluation of water pollution control plans and alternative plans in the interest of the comprehensive and efficient development of the area's water resources for useful and beneficial purposes, thereby meeting emerging needs in a timely manner.

III. Geographic Area Included

This economic base study covers, as a minimum, the MAC Basin Area. The land area is more than 22,000 square miles in extent and includes one-half or more of the land area of 24 Alabama counties and 13 Georgia counties. Approximately 80 per cent of the basin's area lies in Alabama with 20 per cent in Georgia. The basin area accounts for more than one-third of the area of the State of Alabama (between 34 and 36 per cent) but less than one-tenth of the State of Georgia (between 7 and 9 per cent).

A judgment selection of whole counties to delineate the MAC Basin resulted in the following counties to be considered as comprising the total basin area: Alabama counties are (1) Autauga, (2) Baldwin, (3) Bibb, (4) Calhoun, (5) Cherokee, (6) Chilton, (7) Clay, (8) Cleburne, (9) Coosa, (10) Dallas, (11) Elmore, (12) Etowah, (13) Lee, (14) Lowndes, (15) Macon, (16) Monroe, (17) Montgomery, (18) Perry, (19) Randolph, (20) St. Clair, (21) Shelby, (22) Tallapoosa, and (24) Wilcox; and Georgia counties are (1) Bartow, (2) Chattooga, (3) Cherokee, (4) Dawson, (5) Floyd, (6) Gilmer, (7) Gordon, (8) Haralson, (9) Murray, (10) Paulding, (11) Pickens, (12) Polk, and (13) Whitfield.

IV. Subarea Delimitation

Study of Bureau of the Census Economic Subareas and Standard Metropolitan Statistical Areas plus preliminary MAC Basin population projections provided the basis for determining boundaries for the subareas in the basin. (For definitions of SMSA's and State Economic

Areas), see the U. S. Department of Commerce, Bureau of the Census publications, U. S. Census of Population: 1960. Characteristics of the Population, I, xvii, and State Economic Areas: 1951, respectively.

Existing SMSA's or areas expected to become SMSA's by the end of the projection period provided the framework for one group of subareas. Counties not included in SMSA's were grouped according to common economic characteristics.

Some counties not actually in the MAC River Basin were included, either because they were expected to be in an SMSA by the end of the projection period, or because their effect on Basin counties could not be ignored. Other areas, such as Atlanta, Georgia, and Chattanooga, Tennessee, which influence Basin counties, were considered but were not included in the actual projections.

The following subareas were formed either from existing SMSA's or from SMSA's expected to exist by the end of the projection period:

Birmingham, Alabama

Jefferson County, Alabama
Shelby County, Alabama (1980)
Walker County, Alabama (1980)
Blount County, Alabama (1980)

Gadsden-Anniston, Alabama

Etowah County, Alabama
Calhoun County, Alabama (2015)

Montgomery, Alabama

Montgomery County, Alabama
Elmore County, Alabama
Autauga County, Alabama (1980)

Mobile, Alabama

Mobile County, Alabama
Baldwin County, Alabama

Auburn-Opelika, Alabama

Lee County, Alabama (2015)

Rome, Georgia

Floyd County, Georgia (2015)

After the projected SMSA counties were determined, the remaining Basin area was divided into subareas roughly following the State Economic Areas as defined by the Bureau of the Census in 1951.

Care was taken to combine counties with similar economic characteristics, and consideration was given to the effect adjoining SMSA's had on the remaining counties.

The counties outside the SMSA's were grouped in the following manner:

Area 1

Dallas County, Alabama
Lowndes County, Alabama
Macon County, Alabama
Monroe County, Alabama
Perry County, Alabama
Wilcox County, Alabama

Area 2

Cherokee County, Georgia
Clay County, Alabama
Cleburne County, Alabama
Coosa County, Alabama
Haralson County, Georgia
Paulding County, Georgia
Randolph County, Alabama

Area 3

Bibb County, Alabama
Chilton County, Alabama
St. Clair County, Alabama
Talladega County, Alabama

Area 4

Cherokee County, Alabama
Bartow County, Georgia
Chattooga County, Georgia

Gordon County, Georgia
Murray County, Georgia
Polk County, Georgia
Whitfield County, Georgia

Area 5

Dawson County, Georgia
Gilmer County, Georgia
Pickens County, Georgia

FIGURE I-A
MOBILE-ALABAMA-COOSA RIVER BASIN

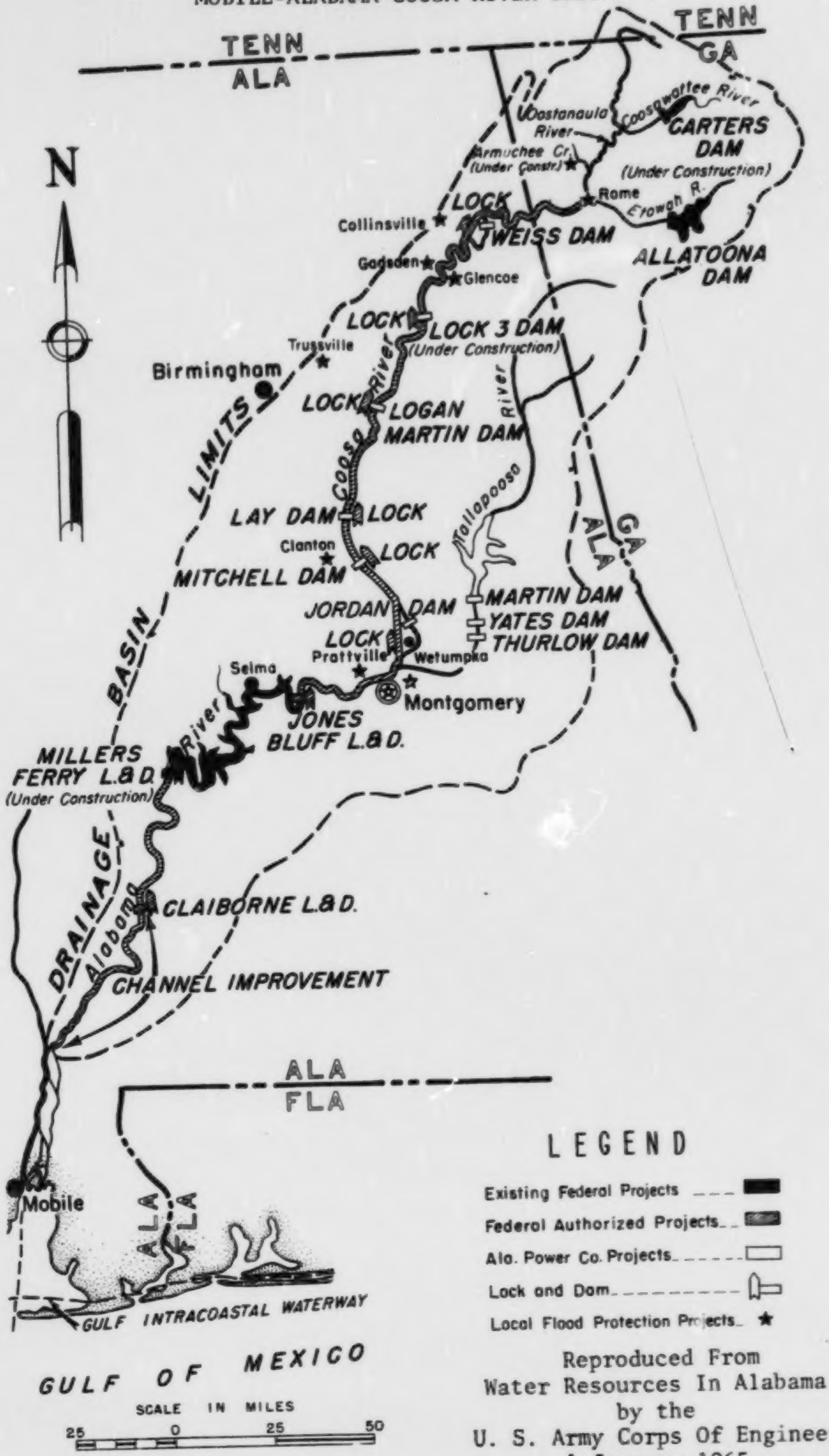
TENN
ALA
TENN
GA
N
Oostanaula River
Coosawattee River
CARTERS DAM
(Under Construction)
Armuchee Cr. (Under Constr.)
Rome
Etowah R.
LOCK
Collinsville
WEISS DAM
ALLATOONA DAM
Gadsden
Glencoe
LOCK
LOCK 3 DAM
(Under Construction)
Trussville
Birmingham
Coosa River
LOCK
LOGAN MARTIN DAM
River
Tallapoosa
LAY DAM
LOCK
Clanton
LOCK
MITCHELL DAM
JORDAN DAM
MARTIN DAM
YATES DAM
THURLOW DAM
LOCK
Prattville
Wetumpka
Selma
Montgomery
JONES BLUFF L.&D.
River
MILLERS FERRY L.&D.
(Under Construction)
BASIN LIMITS
DRAINAGE
Alabama
CLAIBORNE L.&D.
CHANNEL IMPROVEMENT
GA
ALA
ALA
FLA
ALA
FLA
Mobile
GULF INTRACOASTAL WATERWAY
GULF OF MEXICO
SCALE IN MILES
25
0
25
50
LEGEND
Existing Federal Projects
Federal Authorized Projects
Ala. Power Co. Projects
Lock and Dam
Local Flood Protection Projects

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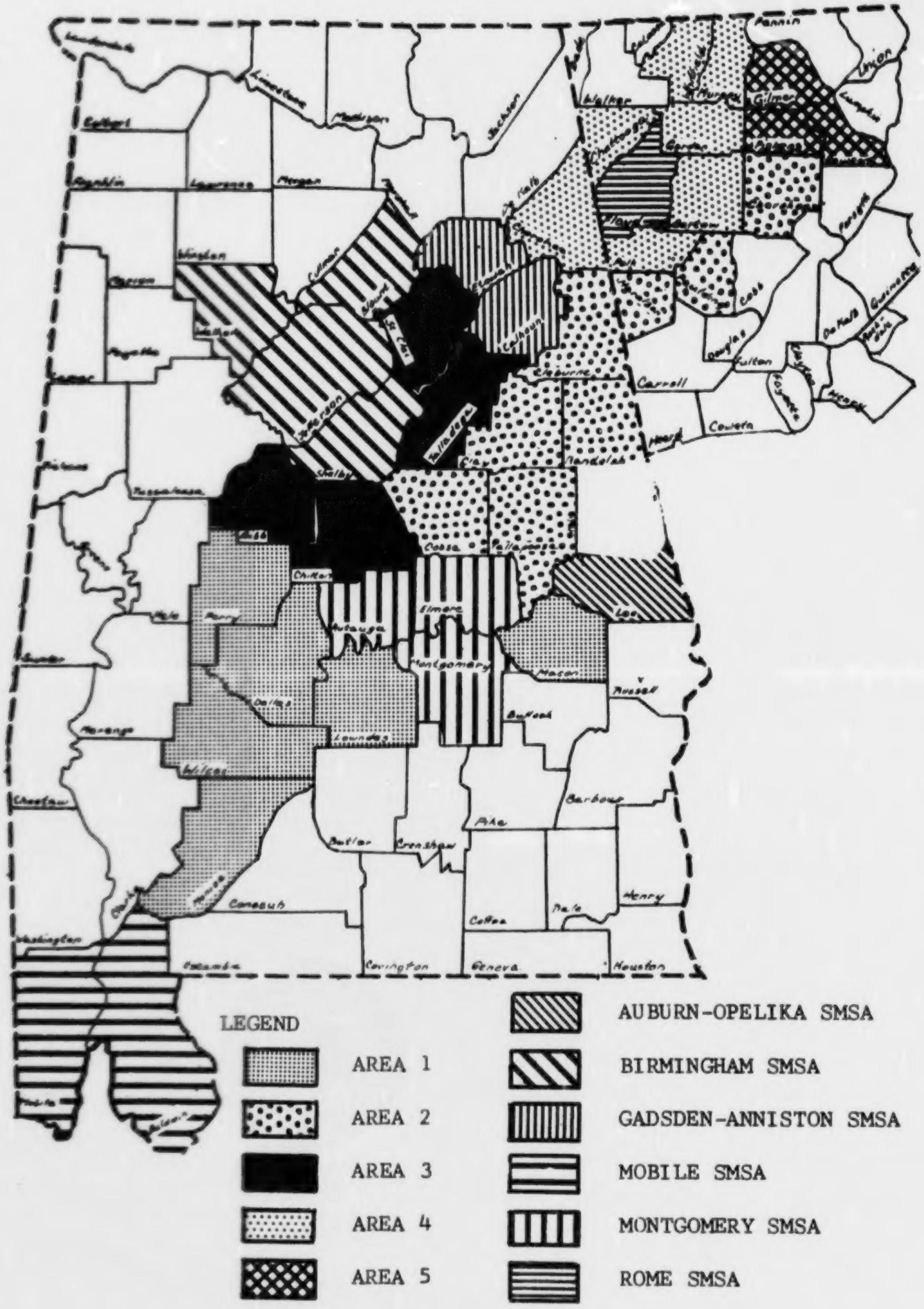
FIGURE I-B

MOBILE-ALABAMA-COOSA RIVER BASIN SUBAREAS


LEGEND
AREA 1
AREA 2
AREA 3
AREA 4
AREA 5
AUBURN-OPELIKA SMSA
BIRMINGHAM SMSA
GADSDEN-ANNISTON SMSA
MOBILE SMSA
MONTGOMERY SMSA
ROME SMSA
Lauderdale
Limestone
Madison
Jackson
Colbert
Franklin
Lawrence
Morgan
Winston
Cullman
Marion
Walker
Fayette
Lamar
Blount
St. Clair
Etowah
Calhoun
DeKalb
Jefferson
Shelby
Talladega
Cleburne
Clay
Randolph
Pickens
Tuscaloosa
Bibb
Chilton
Coosa
Tallapoosa
Perry
Autauga
Elmore
Lee
Montgomery
Macon
Russell
Hale
Sumter
Dallas
Marengo
Lowndes
Bullock
Wilcox
Choctaw
Butler
Crenshaw
Pike
Barbour
Clarke
Monroe
Conecuh
Henry
Coffee
Dale
Washington
Escambia
Covington
Geneva
Houston
Mobile
Baldwin
Fannin
Union
Gilmer
Lumpkin
Dawson
Murray
Walker
Gordon
Floyd
Bartow
Cherokee
Forsyth
Polk
Cobb
Gwinnett
DeKalb
Douglas
Fulton
Carroll
Coweta
Heard
Clayton
Henry

CHAPTER II

M-A-C

Description of the Base Study Area

General Location and size.

Maximum width of the Mobile-Alabama-Coosa River Basin is 110 miles. It extends about 320 miles from southeast Tennessee and northwest Georgia diagonally across Alabama to the southeast corner of the state. The Alabama-Coosa River system drains about 130 square miles in Tennessee, 5,350 square miles in Georgia and 17,320 square miles in Alabama. The Alabama River joins the Tombigbee River which forms the Mobile River. The latter flows southerly for 45 miles into Mobile Bay, an arm of the Gulf of Mexico. Total length of the Coosa-Alabama-Mobile River is over 645 miles.

The MAC River Basin covers a wide range of geologic and topographic conditions, caused by its location at the juncture of five physiographic provinces: the Blue Ridge Province; the Valley and Ridge Province; the Piedmont Plateau; the Appalachian Plateau; and, the Gulf Coastal Plain. The whole area is drained by the Mobile-Alabama-Coosa Rivers and their tributaries. The Coosa River is formed by the junction of the Etowah and Costnaul Rivers at Rome, Georgia. It flows to the west into Alabama to Gadsden and there turns south and joins the Tallapoosa River above Montgomery. At the juncture of the Coosa and Tallapoosa near Wetumpka, Alabama, the Alabama River is formed. The Alabama River then flows to the west to Selma, then toward the southwest until it reaches the Tombigbee to form the Mobile River. The northwestern area of the MAC Basin presents relatively rugged terrain through which the Coosa and its tributaries have cut their channels over time. At Rome, Georgia the low water level elevation at the head of Coosa River is 565 feet; 111 miles downstream at Gadsden, Alabama the elevation of the Coosa at low water is 504 feet; the river level falls 129 feet at Chidersburg; at the mouth of the Coosa its low water level is 124 feet where its waters join with those of the Tallapoosa to form the Alabama River near Wetumpka, Alabama.

The Coosa River channel is 267 miles long. From its head at Rome, Georgia to its mouth it falls in elevation from 565 feet to 145 feet. This fall provides the natural basis for the hydroelectric installations and dams (6 completed) by the Alabama Power Company. Each of the dams backs the waters of the Coosa into lakes which provide recreational potential in addition to electric power. (For details on lock and dam projects see REVIEW OF REPORTS ON ALABAMA-

COOSA RIVER SYSTEM GEORGIA AND ALABAMA Main Report. U. S. Army Engineer District Mobile, Alabama, 15 Apr. 1965).

In contrast to the fall of the Coosa River waters, the Alabama River in its 310 mile of meandering from its head to the point where it joins the Tombigbee River near Calvert, Alabama fall only 106 feet. At that point, the Mobile River carries the waters of the Tombigbee and the Alabama Rivers approximately 45 miles to Mobile at Gulf tide levels. Locks and dams are now under construction at Jones Bluff, Millers Ferry, and Claiborne (near Monroeville) Alabama by the Corps of Engineers. A nine foot channel is being dredged from the mouth of the Alabama to Montgomery, Alabama; plans have been drawn for eventually providing navigation channel from Rome, Georgia to the Alabama River. Within the period for which projections of various developments in the MAC Basin area are being made, it is uncertain whether 2015 is too early for the completion of present plans for navigation on the Coosa. A considerable potential for water transportation on the Mobile-Alabama-Coosa River Basin remains to be developed. Water resources appear abundant for meeting emerging needs for municipal, recreational, electric power development, navigation, and crop production during the projection period and well beyond the year 2015.

Rainfall and Climate

Abundant rainfall (53.9 inches annually) which is fairly uniformly distributed over the year is a natural asset of the MAC River Basin area. Average annual precipitation in the MAC drainage area above Rome, Georgia is 53.8 inches; for the basin area Rome, Georgia to Montgomery, Alabama annual rainfall is 52.77 inches; below Montgomery to Mobile, Alabama the annual average is about 55 inches. March (the wettest month) has an average precipitation of 6.2 inches, and October (the driest month) has 2.4 inches.

Temperatures below zero are occasionally recorded in the Blue Ridge Mountain areas above Rome, Georgia. However, sub-freezing weather is of short duration and the annual mean temperature of the northern portion of the MAC River area is 61 degrees. In the southern portion of the basin area the annual mean temperature is 66 degrees. January, with a mean basin temperature of 48 degrees, is the coldest month and July is the warmest with 80 degrees. The frost-free season varies from about 200 days in the northern valleys to about 260 days in the lower portion of the basin.

With a temperate climate and abundant rainfall The MAC River area supports forests (now covering 64 per cent of the area), and is favorable to agricultural pursuits. Industrial development has in turn been dependent on production of forest and farm products, and on the minerals found in the basin area.

Population

Population of the 41-County in the study area has grown slowly since 1930 when it numbered 1,651,372, and in 1960 total population was 2,253,367. MAC River Basin counties' population increased by 9.38 per cent from 1950 to 1960, compared to a national growth rate of 18 per cent for the same period. The thirteen counties included in the six metropolitan areas of the study area accounted for approximately 63 per cent of the 1950-1960 growth in population, and for 43 per cent of urban population growth. Net population loss was experienced from 1930 to 1960 by fourteen Alabama counties and six Georgia counties included in the MAC study area. Net loss of population was limited to predominantly agriculturally based counties due to outmigration. For many of these counties it is estimated that outmigration will continue to occur, that it will slow down, but by 1980, in many counties, population growth will develop after 1980. Projections of total population for each of the counties in the study area indicate some growth by 2015. Most of the projected growth will probably take place in the presently growing metropolitan areas and the surrounding counties.

Employment

Population depends on employment. The leading source of employment in 1960 in three of the six SMSA's and in four out of the five nonmetropolitan subareas was manufacturing. In subareas 1 and 5, agriculture ranked second as source of employment. Services ranked first in three SMSA's in employment and second in two SMSA's and in three of the other subareas of the study area. This indicates that the whole MAC River Basin area has entered the transition stage of economic development from agriculture as the basic economic activity toward an industry-service oriented economy. However, agriculture will continue to provide employment and income as indicated in the figures projected to the year 2015 and probably beyond.

Statistical data on population, employment, income and other significant parameters are presented for the MAC Basin as a whole, the subareas including six SMSA's and five largely nonurban county groupings, and for each of the 41 counties included in the study area. With few exceptions the figures show that per capita income tends to be lower the farther removed a county is from a growing urban center. Population and economic growth tends to be concentrated in the urban and nonrural counties and subareas of the basin.

The MAC Basin Area, as has been stated, is in a transitional stage of economic development. Changes in agriculture with respect to mechanization and the shift from row crops to pasture and tree farming is eliminating the employment opportunities of the past in farming. Industrial development is underway. Both population growth and industrial expansion is evident in most counties within the Basin. In the pages that follow will be found statistical information on population, employment, sources of employment, and projections of possible trends into the future. The basic materials of this economic base study will be found in the statistics. These are arranged in the same order for the basin as a whole with projections to 1980 and 2015, for the metropolitan and other subareas which comprise the drainage area of the Mobile-Alabama-Coosa Rivers, and in most cases (where ever the data was available) similar information is provided on a county basis. No county projections were made. However, the data is presented and anyone interested in making projections for individual counties--or any other combination of areas for which projections have been made, may use the same methods that have been employed in this study for his own purposes.

It is hoped that the materials presented will provide a basis for planning economic and social development of the area by those interested in improving the economy of the people in this area. The collected and projected information can be used for planning purposes for both the short run and longer periods. There is evidence enough to support the view that the MAC River Basin Area, with its abundant water, temperate climate, long growing seasons, its mineral, forest and agricultural resources can be developed into an economically prosperous area comparable with that of the nation in the not too distant future.

The following tables present a summary of the projected economic parameters for the Mobile-Alabama-Coosa River Basin and each of its subareas. Appendix C of this report gives a detailed breakdown of the projected economic parameters by counties. It is hoped that these projections will be helpful for planning future economic development in the river basin area.

TABLE II-A

SUMMARY OF THE MOBILE AREA ECONOMIC PARAMETER PROJECTIONS FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015

Parameter	1960	1965	1980	2015
Demographic				
Total Population	363,389	397,524	598,641	1,083,300
Urban	283,655	311,236	476,916	918,620
Rural	79,734	86,288	121,725	164,680
Rural Farm	9,206	10,080	8,830	7,950
Rural Nonfarm	70,528	76,208	112,895	156,730
White	251,632	275,523	414,918	750,836
Nonwhite	111,757	122,001	183,723	332,464
Population Density (person/sq.mi.)	127.28	139.24	209.68	379.44
Employment				
Total Employment	122,324	137,582	195,748	342,330
Total Labor Force	131,342	142,314	203,538	357,489
Total Unemployed	9,018	4,732	7,790	15,159
Income				
Personal Income($1,000)	606,039	767,850	1,674,110	4,289,808
Disposable Pers. Inc.	525,007	665,063	1,450,246	3,717,514
Per Capita Income ($)	1,668	1,932	2,797	3,960
Households				
Total Households	96,293	106,629	166,516	321,403
Urban Households	76,735	85,270	135,873	278,370
Rural Households	19,558	21,359	30,643	43,033
Farm	2,431	2,681	2,419	2,324
Nonfarm	17,127	18,678	28,224	40,709
Productivity				
Index	100.00	112.55	172.65	253.47
Value Added by Mfg.(1963) ($1,000)	223,275	233,702	358,490	526,304

continued

TABLE II-B

SUMMARY OF THE MONTGOMERY AREA ECONOMIC PARAMETER PROJECTIONS FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	218,473	226,047	259,670	398,459
Urban	156,352	159,277	186,099	302,654
Rural	62,121	66,770	73,571	95,805
Rural Farm	16,574	13,230	10,500	8,820
Rural Nonfarm	45,547	53,540	63,071	86,985
White	135,545	140,105	160,945	246,966
Nonwhite	82,928	85,942	98,725	151,493
Population Density (person/sq.mi.)	108.32	112.07	128.74	197.55
Employment				
Total Employment	73,334	84,761	91,130	137,615
Total Labor Force	83,417	87,491	94,779	143,445
Total Unemployed	3,138	2,730	3,649	5,830
Income				
Personal Income($1,000)	357,560	446,366	742,299	1,545,681
Disposable Pers. Inc.	313,786	392,028	652,137	1,359,186
Per Capita Income ($)	1,637	1,975	2,859	3,879
Households				
Total Households	58,872	61,472	82,989	124,020
Urban Households	44,257	45,769	55,551	96,081
Rural Households	14,615	15,703	27,438	27,939
Farm	3,880	3,135	2,560	2,205
Nonfarm	10,735	12,568	24,878	25,734
Productivity				
Index	100.00	108.04	167.27	230.90
Value Added by Mfg.(1963) ($1,000)	71,333	73,523	113,833	144,113

continued

TABLE II-C

SUMMARY OF THE AUBURN AREA ECONOMIC PARAMETER PROJECTIONS
FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN
1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	49,754	55,586	63,854	97,982
Urban	31,939	35,682	42,267	68,776
Rural	17,815	19,904	21,587	29,206
Rural Farm	3,050	2,400	1,500	1,250
Rural Nonfarm	14,765	17,504	20,087	27,956
White	31,458	36,020	41,377	63,492
Nonwhite	18,296	19,566	22,477	34,490
Population Density (person/sq.mi.)	81.30	90.83	104.34	160.10
Employment				
Total Employment	17,750	20,592	24,156	37,821
Total Labor Force	18,600	21,012	24,903	39,193
Total Unemployment	850	420	747	1,372
Income				
Personal Income($1,000)	61,394	81,115	121,322	284,148
Disposable Pers. Inc.	54,780	72,376	108,252	253,534
Per Capita Income ($)	1,234	1,460	1,900	2,900
Households				
Total Households	12,499	14,099	16,681	26,439
Urban Households	8,190	9,244	11,362	19,051
Rural Households	4,309	4,855	5,319	7,388
Farm	712	565	359	311
Nonfarm	3,597	4,290	4,960	7,077
Productivity				
Index	100.00	113.86	147.64	217.56
Value Added by Mfg.(1963) ($1,000)	32,172	33,816	43,850	64,370

continued

TABLE II-D

SUMMARY OF THE BIRMINGHAM AREA ECONOMIC PARAMETER PROJECTIONS

FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	746,656	767,641	1,038,083	1,408,062
Urban	558,137	570,482	783,366	1,100,354
Rural	188,519	197,159	254,717	307,708
Rural Farm	17,213	15,010	12,370	9,900
Rural Nonfarm	171,306	182,149	242,347	297,808
White	514,281	530,001	715,583	970,620
Nonwhite	232,375	237,640	322,500	437,442
Population Density (person/sq.mi.)	221.76	227.99	308.31	418.19
Employment				
Total Employment	250,191	282,083	326,947	431,864
Total Labor Force	267,319	294,139	342,567	450,580
Total Unemployment	17,128	12,056	15,620	18,716
Income				
Personal Income ($1,000)	1,514,308	1,884,757	2,910,291	6,228,588
Disposable Pers. Inc.	1,313,948	1,635,506	2,525,740	5,403,930
Per Capita Income ($)	2,028	2,455	2,804	4,424
Households				
Total Households	212,555	218,577	306,395	432,161
Urban Households	162,083	165,357	236,666	343,959
Rural Households	50,472	53,220	69,729	88,202
Farm	4,661	4,123	3,514	2,870
Nonfarm	45,811	49,097	66,215	85,332
Productivity				
Index	100.00	110.34	147.13	238.38
Value Added by Mfg.(1963) ($1,000)	893,065	927,894	1,237,252	2,004,574

continued

TABLE II-E

SUMMARY OF THE GADSDEN-ANNISTON AREA ECONOMIC PARAMETER PROJECTIONS FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	192,858	201,666	276,027	395,192
Urban	122,187	127,546	177,359	263,791
Rural	70,671	74,120	98,668	131,401
Rural Farm	9,671	8,570	6,400	4,800
Rural Nonfarm	61,000	65,550	92,268	126,601
White	159,787	165,366	226,342	324,058
Nonwhite	33,071	36,300	49,685	71,134
Population Density (person/sq.mi.)	165.54	173.10	236.93	339.22
Employment				
Total Employment	60,737	69,412	94,476	132,167
Total Labor Force	69,700	72,600	98,817	138,317
Total Unemployment	8,963	3,188	4,341	6,150
Income				
Personal Income ($1,000)	343,807	419,265	795,770	1,690,693
Disposable Pers. Inc.	303,155	369,791	701,870	1,491,180
Per Capita Income ($)	1,783	2,079	2,883	4,278
Households				
Total Households	53,247	56,119	79,927	118,558
Urban Households	35,174	36,970	53,583	82,434
Rural Households	18,073	19,149	26,344	36,124
Farm	2,499	2,255	1,739	1,344
Nonfarm	15,574	16,894	24,605	34,780
Productivity				
Index	100.00	106.39	148.50	225.75
Value Added by Mfg.(1963) ($1,000)	231,220	236,908	330,691	502,718

continued

TABLE II-F

SUMMARY OF THE ROME AREA ECONOMIC PARAMETER PROJECTIONS

FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	69,130	71,436	85,193	135,280
Urban	37,552	38,804	47,981	78,895
Rural	31,578	32,632	37,212	56,385
Rural Farm	3,056	2,650	2,300	1,700
Rural Nonfarm	28,522	29,982	34,912	54,685
White	59,192	61,435	73,266	116,341
Nonwhite	9,938	10,001	11,927	18,939
Population Density (person/sq.mi.)	134.49	138.98	165.75	263.19
Employment				
Total Employment	26,202	27,109	33,113	53,977
Total Labor Force	27,747	28,717	34,929	56,818
Total Unemployment	1,545	1,608	1,816	2,841
Income				
Personal Income ($1,000)	114,044	143,586	238,029	523,534
Disposable Pers. Inc.	100,622	126,687	210,015	461,919
Per Capita Income ($)	1,671	2,010	2,794	3,870
Households				
Total Households	19,646	20,647	25,654	43,211
Urban Households	11,394	11,940	15,428	25,615
Rural Households	8,252	8,707	10,226	17,596
Farm	807	712	635	507
Nonfarm	7,445	7,995	9,591	17,089
Productivity				
Index	100.00	121.67	165.81	224.12
Value Added by Mfg. (1963) ($1,000)	104,693	112,723	153,616	207,638

continued

TABLE II-G

SUMMARY OF THE AREA 1 ECONOMIC PARAMETER PROJECTIONS

FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	157,270	160,123	184,965	317,521
Urban	42,833	44,092	53,457	114,913
Rural	114,437	116,031	131,508	202,608
Rural Farm	39,391	35,720	25,620	20,840
Rural Nonfarm	75,046	80,311	105,888	181,768
White	52,449	54,069	63,586	113,126
Nonwhite	104,821	106,054	121,379	204,395
Population Density (person/sq.mi.)	31.60	32.17	37.16	63.80
Employment				
Total Employment	46,262	50,120	56,627	90,834
Total Labor Force	50,571	52,546	59,373	95,256
Total Unemployment	4,309	2,426	2,746	4,422
Income				
Personal Income($1,000)	147,606	182,010	311,751	837,321
Disposable Pers. Inc.	137,167	169,141	289,751	777,911
Per Capita Income ($)	939	1,137	1,685	2,637
Households				
Total Households	38,164	39,728	47,929	87,487
Urban Households	11,880	12,376	15,630	35,798
Rural Households	26,284	27,352	32,299	51,689
Farm	8,060	7,521	5,694	4,961
Nonfarm	18,224	19,831	26,605	46,728
Productivity				
Index	100.00	113.67	172.71	289.99
Value Added by Mfg.(1963) ($1,000)	55,914	58,738	89,250	149,855

continued

TABLE II-H

SUMMARY OF THE AREA 2 ECONOMIC PARAMETER PROJECTIONS FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	139,166	144,480	178,301	270,762
Urban	29,007	37,956	50,115	84,600
Rural	110,159	106,524	128,186	186,162
Rural Farm	20,176	17,220	12,040	9,520
Rural Nonfarm	89,983	89,304	116,146	176,642
White	114,150	118,378	146,387	222,688
Nonwhite	25,016	26,102	31,914	48,074
Population Density (person/sq.mi.)	33.66	34.95	43.13	65.50
Employment				
Total Employment	49,406	52,592	65,393	102,052
Total Labor Force	51,533	54,903	68,467	108,304
Total Unemployment	2,127	2,311	3,074	6,252
Income				
Personal Income($1,000)	165,007	201,959	362,736	848,344
Disposable Pers. Inc.	149,366	182,651	328,233	767,570
Per Capita Income ($)	1,186	1,398	2,034	3,133
Households				
Total Households	38,685	40,878	51,666	82,307
Urban Households	8,635	11,465	15,278	26,857
Rural Households	30,050	29,413	36,388	55,450
Farm	5,367	4,606	3,298	2,720
Nonfarm	24,683	24,807	33,090	52,730
Productivity				
Index	100.00	114.92	166.31	249.51
Value Added by Mfg.(1963) ($1,000)	102,068	107,671	155,817	233,766

continued

TABLE II-I

SUMMARY OF THE AREA 3 ECONOMIC PARAMETER PROJECTIONS FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	130,933	138,326	180,893	252,649
Urban	45,652	48,734	72,384	110,251
Rural	85,281	89,592	108,509	142,398
Rural Farm	13,471	11,730	8,990	7,470
Rural Nonfarm	71,810	77,862	99,519	134,928
White	97,196	102,474	133,590	186,156
Nonwhite	33,737	35,852	47,303	66,493
Population Density (person/sq.mi.)	48.23	50.95	66.63	93.06
Employment				
Total Employment	41,163	44,098	58,243	86,274
Total Labor Force	43,899	46,754	61,503	90,953
Total Unemployment	2,736	2,656	3,260	4,679
Income				
Personal Income($1,000)	143,685	170,646	337,271	726,558
Disposable Pers. Inc.	129,764	154,147	304,553	655,873
Per Capita Income ($)	1,097	1,234	1,864	2,875
Households				
Total Households	34,721	37,142	50,067	73,093
Urban Households	12,710	13,984	21,153	33,411
Rural Households	22,011	23,158	28,914	39,682
Farm	3,331	2,934	2,305	1,992
Nonfarm	18,680	20,224	26,609	37,690
Productivity				
Index	100.00	110.88	166.11	241.81
Value Added by Mfg.(1963) ($1,000)	85,772	89,272	133,744	194,694

continued

TABLE II-J

SUMMARY OF THE AREA 4 ECONOMIC PARAMETER PROJECTIONS

FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	164,323	177,561	218,715	345,396
Urban	48,107	54,315	66,838	116,190
Rural	116,216	123,246	151,877	229,206
Rural Farm	26,350	20,230	17,380	14,100
Rural Nonfarm	89,866	103,016	134,497	215,106
White	148,828	161,244	198,890	314,376
Nonwhite	15,495	16,317	19,825	31,020
Population Density (person/sq.mi.)	61.48	66.43	81.82	129.22
Employment				
Total Employment	59,586	64,966	82,910	134,675
Total Labor Force	63,089	68,685	87,485	141,613
Total Unemployment	3,503	3,719	4,575	6,938
Income				
Personal Income($1,000)	240,312	298,731	522,105	1,236,640
Disposable Pers. Inc.	215,952	268,506	469,472	1,111,990
Per Capita Income ($)	1,462	1,682	2,387	3,580
Households				
Total Households	45,549	50,053	63,702	104,869
Urban Households	14,367	16,382	20,481	37,479
Rural Households	31,182	33,671	43,221	67,390
Farm	6,643	5,135	4,573	3,938
Nonfarm	24,539	28,536	38,648	63,452
Productivity				
Index	100.00	114.12	156.57	228.77
Value Added by Mfg.(1963) ($1,000)	228,983	240,913	330,514	482,948

continued

TABLE II-K

SUMMARY OF THE AREA 5 ECONOMIC PARAMETER PROJECTIONS

FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	21,415	22,119	26,022	41,320
Urban	-	-	-	5,400
Rural	21,415	22,119	26,022	35,920
Rural Farm	3,606	3,010	2,100	1,400
Rural Nonfarm	17,809	19,109	23,922	34,520
White	21,016	21,701	25,538	40,545
Nonwhite	399	418	484	775
Population Density (person/sq.mi.)	24.53	25.34	29.81	47.33
Employment				
Total Employment	6,777	6,913	8,245	13,650
Total Labor Force	7,049	7,197	8,587	14,255
Total Unemployment	272	284	342	605
Income				
Personal Income($1,000)	22,994	29,056	51,528	127,199
Disposable Pers. Inc.	21,170	26,742	47,430	117,109
Per Capita Income ($)	1,074	1,314	1,980	3,078
Households				
Total Households	5,849	6,111	7,431	12,201
Urban Households	-	-	-	1,588
Rural Households	5,849	6,111	7,431	10,613
Farm	953	803	577	399
Nonfarm	4,896	5,308	6,854	10,214
Productivity				
Index	100.00	123.92	184.65	275.85
Value Added by Mfg.(1963) ($1,000)	10,922	11,396	16,096	24,223

continued

TABLE II-L

SUMMARY OF THE TOTAL BASIN ECONOMIC PARAMETER PROJECTIONS FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN

1965, 1980, 2015--(continued)

Parameter	1960	1965	1980	2015
Demographic				
Total Population	2,253,367	2,362,509	3,110,364	4,745,923
Urban	1,355,421	1,428,124	1,956,782	3,164,444
Rural	897,946	934,385	1,153,582	1,581,479
Rural Farm	161,764	139,850	108,030	87,750
Rural Nonfarm	736,182	794,535	1,045,552	1,493,729
White	1,585,534	1,666,316	2,200,422	3,349,204
Nonwhite	667,833	696,193	909,942	1,396,719
Population Density (person/sq.mi.)	87.00	91.21	120.08	183.23
Employment				
Total Employment	753,732	840,228	1,036,988	1,563,259
Total Labor Force	814,266	876,358	1,084,948	1,636,223
Total Unemployment	53,589	36,130	47,960	72,964
Income				
Personal Income($1,000)	3,716,756	4,625,341	8,067,212	18,338,514
Disposable Pers. Inc.	3,264,717	4,062,638	7,087,699	16,117,716
Per Capita Income ($)	1,649	1,958	2,594	3,864
Households				
Total Households	616,080	651,455	898,957	1,425,749
Urban Households	385,425	408,757	581,005	980,643
Rural Households	230,655	242,698	317,952	445,106
Farm	39,344	34,470	27,673	23,571
Nonfarm	191,311	208,228	290,279	421,535
Productivity				
Index	100.00	111.60	157.63	237.22
Value Added by Mfg.(1963) ($1,000)	2,039,417	2,126,556	2,963,153	4,535,203

FIGURE II-A
TOTAL POPULATION, LABOR FORCE AND TOTAL EMPLOYMENT
FOR THE MOBILE-ALABAMA-COOSA RIVER BASIN, 1930-2015

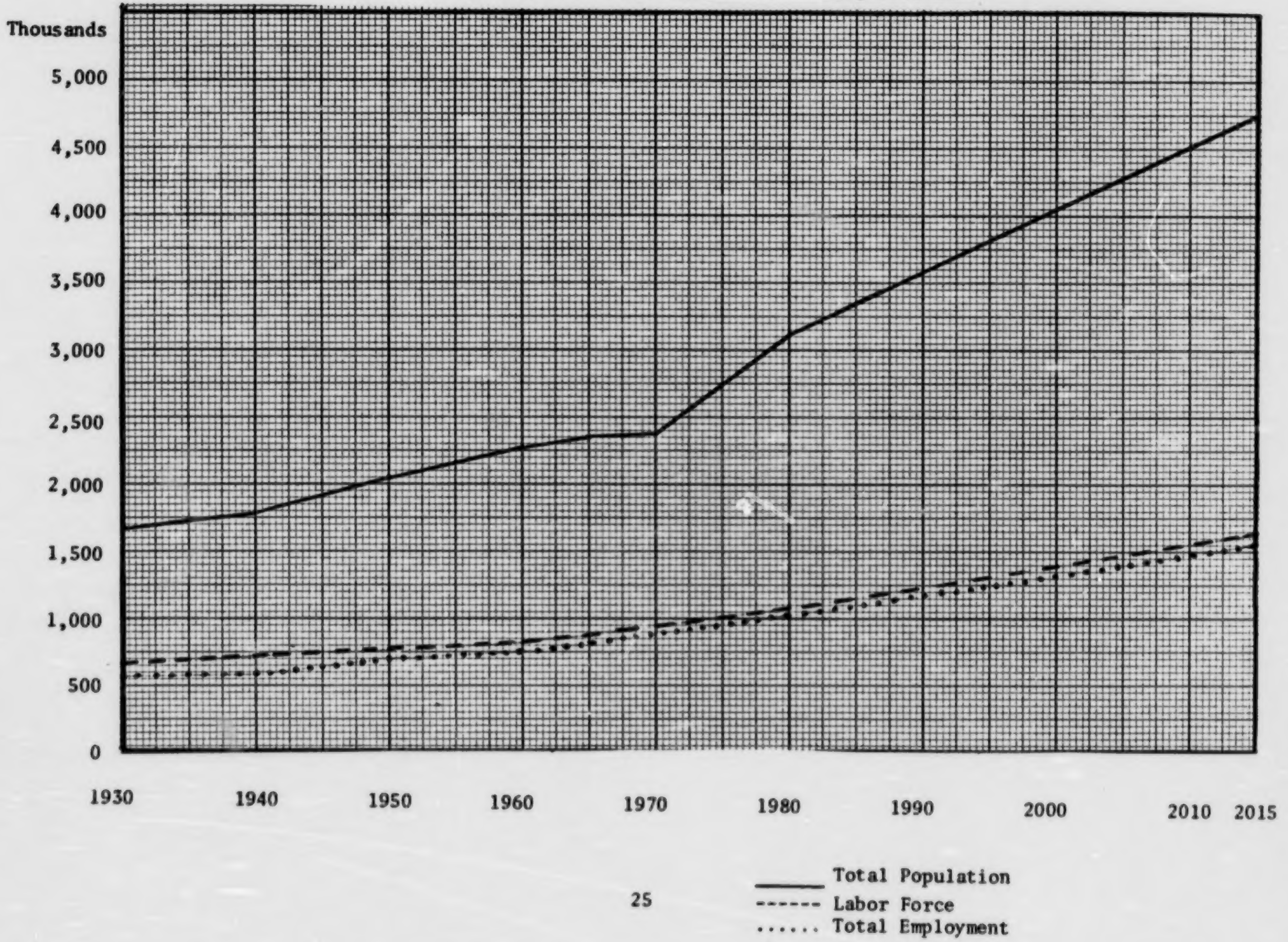


FIGURE II-B

PER CENT CHANGE IN TOTAL POPULATION, TOTAL LABOR FORCE AND TOTAL EMPLOYMENT FOR THE MOBILE-ALABAMA-COOSA BASIN

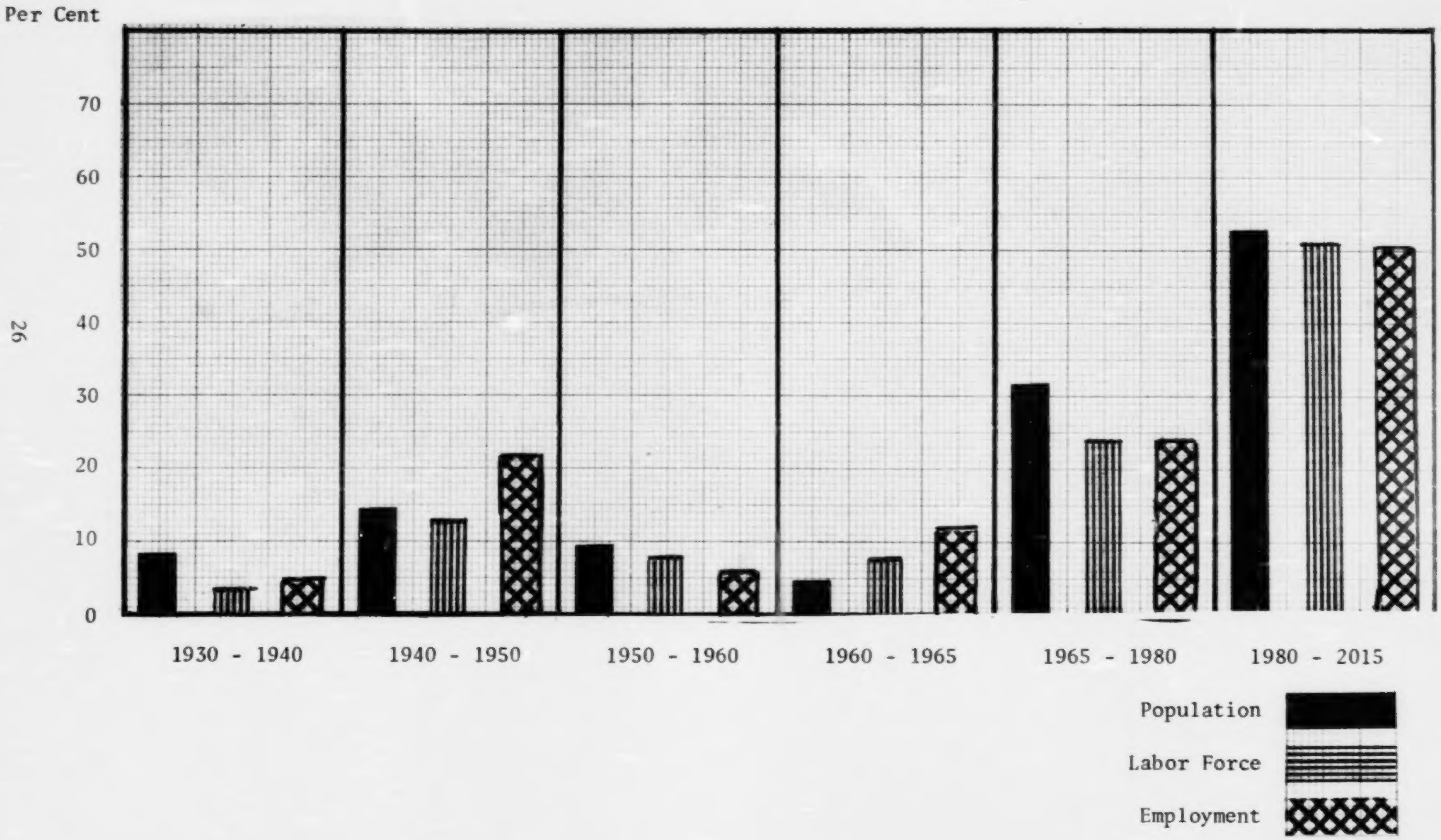


FIGURE II-C
PROJECTED TOTAL INCOME FOR MOBILE-ALABAMA-COOSA RIVER BASIN
1965 - 1980 - 2015

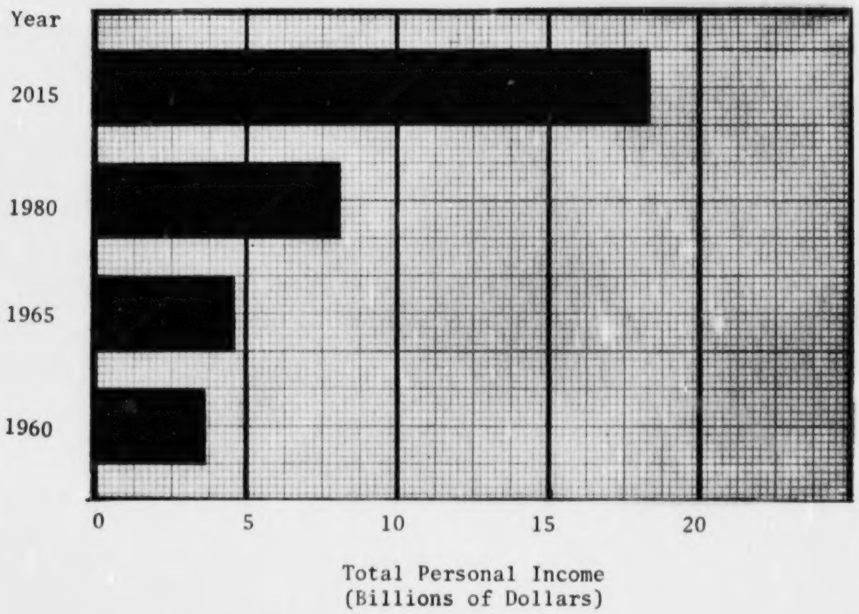


FIGURE II-D
PROJECTED VALUE ADDED BY MANUFACTURE MOBILE-ALABAMA-COOSA RIVER BASIN
1965 - 1980 - 2015

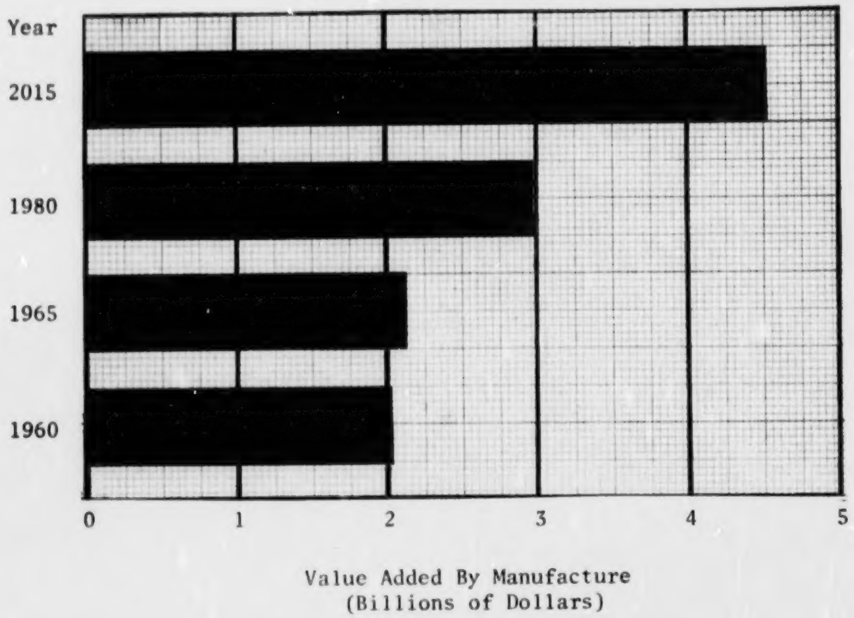
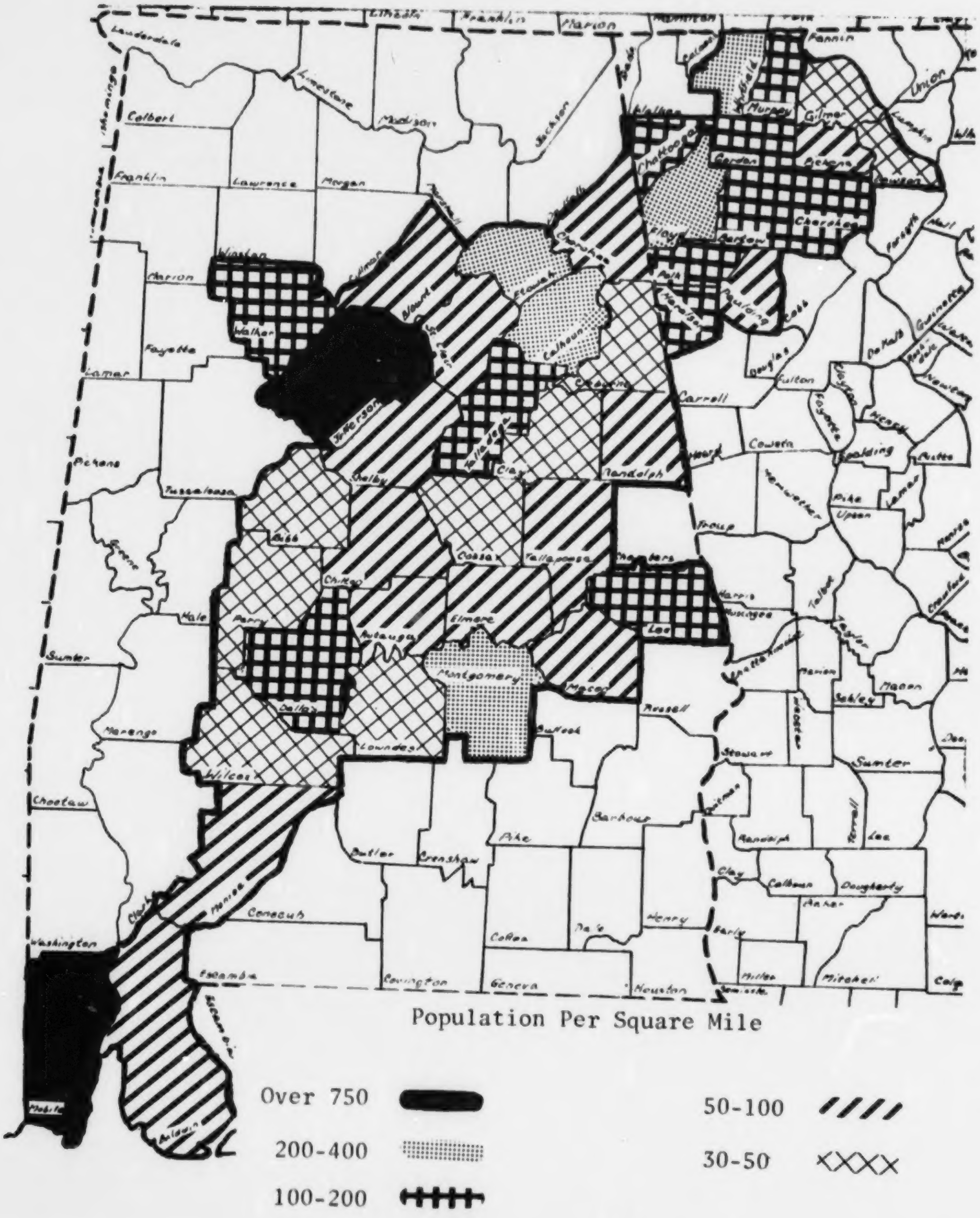


FIGURE II-E
County Population Density For 2015
Mobile-Alabama-Coosa River Basin


Population Per Square Mile
Over 750
200-400
100-200
50-100
30-50
Lauderdale
Colbert
Franklin
Lawrence
Morgan
Limestone
Madison
Jackson
Marion
Winston
Walker
Fayette
Lamar
Jefferson
Cullman
Blount
Marshall
DeKalb
Etowah
Cherokee
Calhoun
St. Clair
Cleburne
Talladega
Clay
Randolph
Pickens
Tuscaloosa
Shelby
Bibb
Chilton
Coosa
Tallapoosa
Chambers
Lee
Greene
Hale
Perry
Autauga
Elmore
Sumter
Dallas
Lowndes
Montgomery
Macon
Russell
Bullock
Marengo
Wilcox
Choctaw
Butler
Crenshaw
Pike
Barbour
Monroe
Conecuh
Coffee
Dale
Henry
Washington
Clarke
Escambia
Covington
Geneva
Houston
Mobile
Baldwin
Walker
Murray
Gilmer
Fannin
Union
Whitfield
Chattooga
Gordon
Pickens
Dawson
Floyd
Bartow
Cherokee
Forsyth
Polk
Paulding
Haralson
Cobb
Douglas
Fulton
Carroll
Coweta
Fayette
Spalding
Heard
Meriwether
Troup
Pike
Upson
Harris
Muscogee
Talbot
Taylor
Chattahoochee
Marion
Schley
Macon
Stewart
Webster
Sumter
Quitman
Randolph
Terrell
Lee
Clay
Calhoun
Dougherty
Early
Baker
Miller
Mitchell
Seminole

CHAPTER III

NATIONAL ECONOMIC GROWTH PROJECTIONS

1980, 2000, 2020*

Longer-run economic policy and related commitments involve appraisals and assumptions regarding future expansion in the demand for goods and services and in general economic growth. Water and related land resource development often requires either large control structures which may endure for a period of 50 years or more, or systems of river basin or watershed works which affect many people, many square miles, and many economic activities. The scale of these developments requires that consideration be given to the total imparts, physical and social, of these projects on the people and the economy they are intended to serve.

The necessity of uniform assumptions of future economic growth as a frame of reference for water resource planning has been evident for some time. Since such planning is conducted by several Federal agencies, usually on a basin or other regional basis, it is logical that each agency and each study adhere to the same set of assumptions regarding the future size and characteristics of the national economy. These projections of general economic growth serve as bench mark guides for more detailed analysis relating to water and related land resource development, and other long-run considerations.

Appraisals of the need for and impact of water resource development on the economy must be viewed from a larger context than the

Note: This chapter is reproduced from "Economic Base Study of the Pascagoula Pearl and Big Black River Basins Study Area." Vol.2, Michael Baker Jr., Inc., Jackson, Mississippi. These Projections were used in the MAC River Basin in order to provide a consistent base for studying national trends.

*The projections of national economic growth indicators used throughout the Study were taken from "National Economic Growth Projection 1980, 2000, 2020," a report of the Economic Task Group of the Ad Hoc Water Resources Council Staff, July, 1963. This report is reproduced herein with minor editing of table and figure numbers and changes in format.

immediate project area. This requirment is clearly established by experience, and it is restated in the new "Standards, Policies, and Procedures" for water resource development issued in May, 1962, by the President and published as Senate Document No. 97, 87th Congress, 2nd Session. These standards stress that planning must take place from a national viewpoint, though recognizing regional, State and local objectives as well. The planning objectives consist of national economic development, preservation of resources, and the general well-being of people. These objectives, in conjunction with the necessity of establishing the economic validity of the projects, require decisions on the probable directions and levels of national economic growth. The consequent investments in water resource development contribute to the rate and general pattern of economic growth.

The following report develops a framework of assumptions for the national economy proposed for use in planning water resource developments. It outlines the major conclusions regarding economic growth based on the assumptions, methodology and data sources specified for the analysis. The report, drafted by Rex F. Daly, Chief, Outlook and Projections Branch, Economic Research Service, reflects the consensus of technicians in other agencies as well as those of the Economic Task Group of the Interim Water Resources Council.

SUMMARY

Population and the economy will continue to grow in the next five or six decades - probably much as it has in recent decades. The population of the U. S. in 1959-61 averaged nearly 181 million person, up 37 per cent from 1940. There was an upsurge in population following the Second World War and this accelerated rise continued during the 1950 decade. Population growth has been a major contributor to the expansion in domestic demand for food and other goods and services. Future trends in birth rates may not hold at the levels of recent years. But, the number of women in the most fertile 20-34 year age groups will increase sharply in the next decade. The most widely used population projections for 1980 fall in a range some 35 to 45 per cent above 1960. About the same annual rate of growth - between 1.5 and 2.0 per cent - is projected for the period 1980 to 2020. The middle of this projected range would result in a population of around 254 million by 1980, 358 million by 2000 and over 500 million by 2020. The lower side of the projected range is consistent with the Bureau of the Census No. III projection which assumes a gradual decline in birth rates; the higher side is consistent with the Census No. II projection which assumes birth rates to remain around the 1955-57 average until 1980, then slowly decline beyond 1980.

A growing and increasingly prosperous population expands the demand for consumer goods and services, both private and public, as well as the business demand for supporting capital goods. In the 20-year period 1940 to 1960, the gross product of the economy more than doubled. The economy will continue to grow, possibly at a more rapid rate than in recent years. Assumptions on which the medium growth projections were based indicate an annual increase in the GNP of about 3.8 per cent per year in the next two decades from the 1959-61 output rate when unemployment was relatively high. This would more than double the gross product of the economy in that period. Although projected annual growth from 1980 to 2020 is around 3.5 per cent per year, this rate also about doubles the gross national product in two decades. Accordingly, the medium gross product projection for 1980 is more than 4 times and for 2020 more than 8.5 times the 1959-61 average. This rate of expansion in the general economy is based on the projected growth in population and a projected rise of around 50 per cent per capita output and real income in a period of two decades. Real income per person is expected to more than double by 1980 and by 2020 to more than triple that in 1959-61.

TABLE III-A
NATIONAL ECONOMIC GROWTH PROJECTIONS TO 2020

Item	Average 1959-61	Projections 1980 Total	2000 Total	2020 Total
Population [1]	180.8	254	358	502
Labor Force [2]	73.1	104	147	206
Employment	68.9	100	141	197
Gross National product [3]	515	1,100	2,230	4,520
Gross Product per worker [3]	7,475	11,000	15,800	22,900
Disposable Personal income [3]	356.9	762	1,550	3,140
Per Capita	1,977	3,000	4,300	6,300

[1] Population of the U. S. as of July 1, including Alaska and Hawaii
[2] Including military
[3] In 1962 Dollars

In addition to swelling markets for consumer goods, population growth also provides the labor force and management skills required to organize and carry out an economic expansion program. Increases in the labor force, follow very closely population growth. However, there are a number of pronounced trends in labor force participation by age and sex groups of the population - toward more women workers, toward fewer workers in the lower age groups, and toward more workers in the higher age groups. Overall, the labor force makes up a fairly stable percentage of the total population. In recent decades a significant part of the impact of labor force growth has been offset by a continued decline in the number of man hours worked per year. This annual downtrend of around -0.5 per cent per year reflects the long-term decline in the length of the work week as well as the trend toward annual and longer vacations.

Output per man hour in the private nonfarm sector of the economy trended upward in the postwar years at an annual rate of more than 2.4 per cent. The gross product per man hour in agriculture, though smaller than in the private nonfarm sector, rose at an annual rate of about 5.5 per cent as farms became larger and increasingly mechanized. These productivity rates combine to an average annual increase of 2.6 per cent for the economy as a whole during the postwar years. Output per man hour for the economy was projected to rise about 2.5 per cent annually from 1960 to 1980 and by around 2.3 per cent per year beyond 1980. These gains imply increased use of capital per worker, continued technological innovations, and a growing well-trained labor force.

NATURE, LIMITATIONS AND USES

Long-run economic growth reflects the whole gamut of forces influencing economic activity. None of these forces can be considered as given or determined outside the entire system of cause and effect. The history of economic development amply demonstrates that major implementors of economic growth vary from one period of history to another. Accordingly, models of economic growth greatly oversimplify the problems of economic projection. New data, improved economic theory and much more sophisticated statistical techniques will provide better analyses of the influence of demand changes and the contribution of labor, capital and technology to potential economic growth. But, the future is uncertain and will continue so. Despite limitations in predicting the future, long-run appraisals will continue to be made. Long-run decisions require judgments about the future and often these decisions are based on fragmentary supporting analyses. Fortunately, many decisions involving long-run commitments require only a general judgment about economic growth.

A general economic projection for a period as long as 50 years can be little more than an assumed point of reference. Longer-run projections seldom reveal problems not already anticipated, although they may permit a rough quantification of problems and the impact of alternative courses of action. These limitations, in both our ability to project and on the use of projections, should be recognized and made known to users.

METHODOLOGY AND MAJOR ASSUMPTIONS

The scientific appraisal of the future must rely heavily on historical trends and relationships. Methodology and techniques of analysis used in appraising general economic growth are usually relatively simple, though they need not be simply an extension of trends. However, results of the scientific forecast usually recognize persistent long-run trends in labor force participation of the population, hours worked per week, productivity and measure of technological development.

Population projections for this appraisal are based on Census Bureau porjections extended to 2020. Population growth and trends in participation of men and women by age groups determine the size of the labor force. Employment levels assumed and trends in hours worked per person specify projected increases in labor inputs. The potential gross national product of the economy - the product of employment, hours worked per man and output per man hour - has been projected on the basis of these factors.

The output potential can be roughly split into major sectors such as the private nonfarm sector, agricultural sector and Government sector. The major expenditure categories - consumption, investment and Government - and the resulting income flows can also be approximated. Projected demand increases provide a basis for some of the more detailed projections, but usually the details reflect current or recent relationships including the tax structure, legal structure, divident policy and the many institutional arrangements under which the economy operates.

The general conclusion possible from projections summarized above arise from the assumption that population and the economy will continue to grow much as they have in the last 10 to 20 years. Generally high employment levels were projected, though some variation in unemployment rates was specified between the high and low projections. The projected framework assumes no war or changes in international tensions serious enough to materially influence resource use. Likewise, no serious extended depression was assumed, though this would not preclude cyclical variations in economic activity.

POPULATION GROWTH AND THE LABOR FORCE

In an expanding prosperous economy such as the U. S., population growth has been the major influence on consumer demand for goods and services. The businessman's demand for capital equipment likewise depends primarily on the consumer market for the goods he produces. In addition to an expanding market, population growth also has provided the labor and the management skills required to support and direct U. S. economic growth.

Population growth in the U.S. has responded to changes in economic activity, war and other social upheavels. But a few attempts have been made to develop a theoretical and empirical framework in which to explain and measure the net influence of factors contributing to population growth.[1] It is significant, however, that demographers today are not projecting a peaking out of U. S. population in the next half century. These projections of a stable population were the major basis for such theses of the period as "underconsumption," "mature economy" and "stagnation" indications of the influence of "the times."

During the past 50 years the rate of population growth has slowed from about 2.5 per cent per year around the turn of the century to an average of less than 1.5 per cent per year during 1910 to 1930 and about 1 per cent per year from 1930 to 1945. However, the "population explosion" following the war resulted in an annual growth rate of 1.7 per cent from the period 1945 to 1960. And population grew at an annual rate of nearly 1.75 per cent per year from 1950 to 1960.

There were nearly 181 million people in the 50 states of the U. S. in 1960. Except for 1962, population growth in recent years has approximated 1.7 per cent per year - about in line with the Census No. II projection. Does the slight easing of birth rates in 1962 signal a trend? We do not know, but the history of population projections show a tendency to underestimate growth. Moreover, the sharply rising number of women in the productive 20-34 age groups provide the potential for a continued growth in births, as least for the next two or three decades. Probable variations in trends in mortality and immigration rates are not expected to materially influence population growth.

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[1] Raymond Pearl in BIOLOGY OF POPULATION GROWTH, 1925, describes a "natural law" which was essentially a logarithmic growth curve based on a growth of yeast cells. It is interesting that his projected growth to 1950 was quite accurate.

Population was projected to 1980, 2000 and 2020 for this appraisal on the basis of the Bureau of the Census No. II and No. III projections. The Census No. II projection, among other things, assumes that fertility rates will continue around the 1955-57 average until around 1980 and then decline to the level of birth rates in 1949-51. The lower No. III projection, which is preferred by some analysts, assumes that fertility rates would decline gradually to around the average rate of 1949-51 by 1965-70 and hold steady to around 1980. Projections beyond 1980 assume a continued declining birth rate to levels existing in 1941-42.[1] The resulting population projections for 1980 range between 35 to 45 per cent above 1960; the middle represents about 254 million people. For the year 2020 projections range from 443 to 560 million people with an average around 500 million. The latter is more than 2.5 times the present U. S. population.

THE LABOR FORCE

Those people over 14 years and willing and able to work make up the labor force. Growth in this work force as indicated above, depends primarily on population growth. There can be, however, rather wide variations in the rates at which men and women participate in the work force. As a result, the size of the labor force can change considerably over short periods in response to changing economic conditions. For example, war-time pressures resulted in a sharp rise in the number of persons entering the labor force. Likewise, in periods of slow economic activity the labor force often grows slowly.

Over long-run periods, the number of persons entering the labor force make up a fairly stable proportion of the population over 14 years and also of the total population. This overall stability marks some fairly steady long-run trends in rates of participation in the labor force by components of the total population. The trend toward more women workers has been largely offset by trends toward fewer male workers under 20 and over 60 years of age in the working force. The latter trends reflect pressures for more schooling and the more widespread tendency for retirement after age 60. Better health and longer life could moderate the latter trend. An acceleration in the tendency toward more training also may influence the number of younger workers.

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[1] CURRENT POPULATION REPORTS, Series P-25, No. 187, "Illustrative Projections of the population of the U. S. by Age and Sex: 1960 to 1980," No. 10, 1958; and POPULATION PROJECTIONS AND ECONOMIC ASSUMPTIONS, Senate Select Committee on National Water Resources, Committee Print, No. 5, March, 1960.

The projected labor force for 1980 ranges between 100 and 108 million.[1] This range compares with an average labor force of 73.1 million in 1959-61. Both the base year and the projected labor force include the military. Extensions of labor force growth to 2020 result in an increase to around 180 to 230 million workers.

EMPLOYMENT AND THE WORK WEEK

Growth in employment will reflect, among other things, the rate of expansion in economic activity, trends in hours worked per man, productivity trends and the size of the labor force. Accordingly, unemployment rates may vary secularly over time as well as cyclically with short-run variations in economic activity. With the simple analytical frameworks used for longer-run projections, unemployment levels are generally specified by assumption. In the period 1959-61 unemployment was equal to 5.7 per cent of the labor force. In general, the projections assume relatively high employment rates; the lower assumes unemployment at 5.5 per cent of the labor force; the higher 3.5 per cent; and the middle projection, 4.5 per cent.

The persistent long-run decline in the length of the work week, as well as the trend toward more and longer vacations, has resulted in a gradual downtrend in hours worked per man. This decline is expected to continue. For the economy as a whole, average hours worked per man year declined more than 10 per cent in the past two decades. The decline in the next half century was assumed at around 20 per cent, though this need not imply a work week shorter than 30 to 35 hours. Annual vacations may account for a growing share of the decline in hours worked per man.

PRODUCTIVITY TRENDS - OUTPUT PER MAN HOUR

Output per man and per man hour are the most convenient and widely used measures of "productivity," loosely defined. Obviously, output per man hour does not measure the contribution of labor only. Productivity also depends on the machinery and other capital associated with labor technological development, rate of utilization of resources, training of labor and management, and many other influences.

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[1] The lower projection approximates that in SPECIAL LABOR FORCE REPORT, No. 24, Bureau of Labor Statistics.

The rise in output per man hour is one of the most steady and persistent trends observed in the economy. This uptrend, particularly since the thirties, has reflected a very rapid increase in output per man hour in agriculture. However, the impact of rising agricultural productivity on the economy is reduced as agriculture becomes a relatively smaller share of the total economy. In projecting output per man hour in agriculture, it seemed logical to extend recent rapid increases until productivity in agriculture approaches and blends into productivity rates assumed for the nonfarm sector.

In the Government sector, projections of productivity present a rather difficult conceptual and statistical problem. Since no product is sold, the gross national product - value added - of the Government sector is valued at cost. This includes primarily wage and salary costs of employees and, as defined, output per man hour and per worker do not increase. In order to avoid absurd results, it was assumed that projected output per man hour in Government would rise, at about the same rate as in the private sector of the economy.

In the private nonfarm sector, output per man hour rose about 2.35 per cent per year in the past two decades. In the same period, annual output per man hour in agriculture rose more than 4.7 per cent. These combined to a productivity rate for the general economy a little over 2.6 per cent per year. Future trends in output per man hour generally reflect trends of the last two decades with some variation from the slow to the fast growth framework. The medium growth projection reflects trends of the past two decades; high growth is based on trends of the past decade; and slow growth on the 1956 to 1961 trend.

OUTPUT POTENTIAL: PROJECTIONS TO 1980 AND 2020

The gross national product is a comprehensive measure of the economy's output of goods and services. In any given year, it represents the value of all goods and services produced. This dollar aggregate includes the food, automobiles, and other consumer goods; machinery, plants and other capital goods; and the services demanded by consumers. Output of these goods and services computed in terms of constant 1954 dollars, provides a measure of the gross product of the economy. Available price indexes for the major sector accounts (price deflators) also make it possible to express total output in constant dollars at the price level of a given period.

The gross product of the economy totaled $440 billion (constant 1954 dollars) in 1960. This was about 2.14 times that in 1940. This increase approximates an annual growth rate of 3.87 per cent. Employment rose during this period at an average rate of 1.84 per cent per year, while hours worked per man year declined at a rate slightly more than -0.6 per cent per year. With this offset, total man hours worked increased about 1.2 per cent per year. The product of labor input rising at 1.2 per cent per year and output per man hour rising 2.65 per cent per year results in GNP growth at an annual rate of 3.87 per cent per year.

TABLE III-B
PRODUCTIVITY TRENDS AND ASSUMPTIONS: ANNUAL INCREASE IN OUTPUT PER MAN HOUR

Period	Private Nonfarm	Agriculture[1]	Total Economy
	Percent	Percent	Percent
1940 to 1961	2.35	4.74	2.62
1950 to 1961	2.44	5.68	2.60
1956 to 1961	2.06	4.94	2.24
Projected			
1960 to 1970			
Low	2.1	4.7	2.4
Medium	2.3	5.2	2.6
High	2.5	5.7	2.8
1960 to 1980			
Low	2.1	4.6	2.3
Medium	2.3	5.0	2.5
High	2.5	5.4	2.7
1980 to 2000			
Low	2.1	3.3	2.2
Medium	2.3	3.4	2.4
High	2.5	3.5	2.6
2000 to 2020			
Low	2.1	2.1	2.1
Medium	2.3	2.3	2.3
High	2.5	2.5	2.5

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[1] Recent repid increases in output per man hour in agriculture were extended until they approached and blended into productivity rates for the nonfarm sector around 1990.

The medium level projection of the gross national product rises from the 1959-61 average to 1980 at an annual rate of 3.85 per cent. Projected employment increases, from the relatively high unemployment period 1959-61, at a rate of 1.87 per cent per year. But projected hours worked per man decline by about -0.5 per cent per year limiting the increase in total man hours worked to about 1.3 per cent per year. The product of this labor input, with projected output per man hour rising an average of 2.54 per cent per year, results in projected growth in GNP of 3.85 per cent per year from 1959-61 to 1980. Part of this rise springs from the assumed higher rate of employment than in 1959-61. In the period 1980 to 2000 and 2000 to 2020, the medium GNP projection rises about 3.6 per cent per year. This growth reflects an annual increase of about 1.26 per cent per year in total hours worked (employment rises 1.7 per cent and hours per man declines -0.4 per cent). The annual increase in output per man hour averages around 2.3 per cent per year. Under these assumptions, the gross product of the economy a little more than doubles in a period of two decades and the gross product per person and real per capita income increases around 50 per cent.

TABLE III-C

OUTPUT, EMPLOYMENT AND PRODUCTIVITY: PROJECTED MEDIUM ANNUAL GROWTH RATES FOR SELECTED PERIODS

Item	1940 to 1960	1960 to 1980[1]	1980 to 2000
	Percent	Percent	Percent
Gross national product	3.87	3.85	3.62
Employment	1.84	1.87	1.73
Hours worked per man	-0.61	-0.50	-0.43
Total hours worked	1.19	1.28	1.26
Output per man hour	2.65	2.54	2.33

[1] The base year is the 1959-61 average. Unemployment averaged 5.7 per cent of the labor force in this period while projected rates assumed unemployment at 4.5 per cent. This accounts for part of the relatively high projected growth in employment in the gross national product in 1980.

MAJOR SECTORS OF THE GROSS NATIONAL PRODUCT

Growth in the overall gross product would be adequate for most uses as a projected bench-mark for the economy. However, the probable growth in agriculture should be explicitly specified for many resources development problems. Consequently, the projected gross product was roughly approximated for the private nonfarm sector, agriculture and the Government sector.

Agricultural Sector

Output of farm products was projected on the basis of growth in population and the demand for farm products. Recent trends and detailed analyses for agriculture indicate that the domestic market for farm products rises at about the same rate as population. Extension of this relationship seemed the most logical assumption for such long-run projections. Combined utilization of farm products in 1961, in both domestic and export markets, was about in balance with total supply - output plus imports. Accordingly, 1961 was used as a base from which to project agricultural output and the farm GNP.

Exports of farm products in 1961 were equal to about 15.5 per cent of farm output; imports, many of which are noncompeting commodities, were equivalent to about 13.8 per cent of farm output. Projecting total farm output at the same rate as domestic demand in effect implies a proportionate increase in both exports and imports.

TABLE III-D

GROSS NATIONAL PRODUCTS, POPULATION, EMPLOYMENT AND PRODUCTIVITY, 1959-61 AND PROJECTIONS TO 2020[1]
(Gross national products in 1954 dollars)

Item	Unit	Average 1959-61	Medium Level Projection 1980	2000	2020
Population	Mil.	180.8	254.0	358.0	502.0
Labor force	Mil.	73.1	104.0	147.3	206.2
Employment	Mil.	68.9	99.8	140.6	196.9
Unemployment	Mil.	4.2	4.7	6.9	9.3
Gross national product	Bil.	438.9	934.0	1901.3	3848.7
Private nonfarm	Bil.	382.6	836.2	1722.4	3511.5
Agriculture	Bil.	21.6	27.1	34.7	45.3
Government	Bil.	34.7	70.7	144.2	291.9
Gross product per capita	Dol.	2,428	3,677	5,310	7,667

[1] The GNP projections can be converted to approximate 1962 prices by applying the following inflation ratios: Total GNP x 1.174; private nonfarm x 1.156: agriculture x 0.960; and Government x 1.479.

Output of farm products is only partly a net contribution of the agricultural sector. Machinery, equipment, fertilizer and many other nonfarm inputs are reflected in total farm output, but are a contribution of the nonfarm sector. For example, in the period 1945 to 1961, the farm output index rose by 1.8 per cent per year. But inputs of nonfarm intermediate products increased by more than 2.5 per cent per year and gross products of agriculture rose about 1.25 per cent per year. In 1959-61 agriculture's gross product averaged less than 5 per cent of total GNP; it was 8.5 per cent in 1940. The gross product of agriculture is projected to rise at about 1.25 per cent per year. But with the economy growing much more rapidly, the farm GNP would become a progressingly smaller share; about 3 per cent by 1980 and less than 1.5 per cent by 2020. Growth in agriculture, with the productivity assumptions and hours worked per man assumed above, would result in a further decline in employment in agriculture from 5.67 million workers (labor force concept) in 1959-61 to about 3.2 million by 1980 and around 2.2 million by 2020.

Government Sector

The Government gross products, as outlined above, reflects employment and wages and salaries incurred for public services. Government GNP is less than budget expenditures and is also less than income and product expenditures for goods and services. Except for war periods, changes in Government GNP have been about proportional to changes in total GNP. In 1959-61, the gross product of Government averaged about 8 per cent of GNP; in 1940 about 8.5 per cent.

In projecting the Government sector, employment was increased at the same rate at total employment.[1] Output per man hour and hours worked were assumed to change at the same rates as for the private nonfarm sector. These assumptions result in Government gross product rising at about the same rate as total GNP, continuing around 8 per cent of combined output of goods and services.

Private Nonfarm Sector

The private nonfarm sector has tended to grow a little more rapidly than other sectors, reflecting relatively more rapid expansion in the demand for nonagricultural goods and services.

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[1] Employment includes all Government (Federal, State and local) wage and salary workers less employees in government enterprises and plus the military.

Private nonfarm gross product was equal to 87 per cent of the economy's output in 1959-61; about 83 per cent in 1940. By 1980 projected private nonfarm product would total about 89 per cent and by 2020 about 91 per cent of the gross national product. Under the assumptions and analytical framework described, the private nonfarm gross product is partly a residual. The gross product and employment in the agricultural and Government sectors are determined as described earlier. Nonfarm employment - total less agriculture and Government- with assumed man hours and productivity provide the basis for projected private nonfarm gross product.

USE AND VARIATION IN PROJECTIONS

The general framework projections outlined above are for use as bench-mark assumptions for more detailed projections for agriculture and forestry, regional analyses, detailed river basin investigations, conservation and flood control studies and similar land and water resource investigations. It was considered desirable for this use to include several statistical tables in the Appendix as a sort of "kit of tools" in order that the materials may be used effectively by technicians preparing water resource investigations. The data are carried out in more detail than can be justified primarily as a convenience in statistical manipulation. Needless to say, no such accuracy is implied.

In presenting an assumed framework in 1962 dollars, for example, or in comparisons with other projections on a different base, price deflator indexes will be necessary in order to convert projected 1954 dollars aggregates. The following price adjustment ratios approximate deflator indexes (1954=100) for these sectors.

Alternative assumptions also may be built up from the basic projections presented. The medium economic growth assumptions, for example, might be combined with the high population assumption, particularly for projections 10 to 15 years ahead. This would require that the high labor force projection be combined with the unemployment rate, productivity, and hours worked per man for the medium economic growth assumption.

The agricultural GNP, under the projection technique used, would be directly related to the population assumption. A similar combination, using the lower population assumption, may be preferred by some analysts for the very long-run projections. But the results of these variations in assumption are largely a manipulation of numbers; each would tell about the same story and would not result in a materially different decision than the original projected framework.

CHAPTER IV

METHODOLOGY

Projections in this study were made with respect to the purpose set forth in the contract which states that "a major purpose of the economic base study is to provide a framework within which programs and projects for water quality control may be appropriately formulated and evaluated." (p.2) Further, the assumptions concerning general conditions as set out in the contract were observed. These are "Basic projections will be based on the same general assumptions as the national and regional projections, i. e., (1) that there will be no major wars or depressions, and (2) that relatively full employment will prevail for the nation as a whole." (p.9)

The major items projected were population, labor force, employment, personal income, and productivity. Various breakdowns of these items were projected for the MAC Basin, subareas, and counties within the subareas.

In an effort to establish general relationships between population and employment a mathematical model was used in the initial phase of developing the projections. The model used was "A Dynamic Model of the Economy of the Susquehanna River Basin" by Battelle Memorial Institute in Columbus, Ohio. A general description of this model is found in Chapter 5 of this report, and a detailed description may be found in the supporting data.

The main purpose for using the model was to develop some general economic parameters for the basin and its subareas. In order to obtain realistic relationships, several areas outside of the basin were included in the model analysis. For example, the Atlanta SMSA was included in the study of the Georgia portion of the basin and the Birmingham SMSA in the Alabama section of the basin.

The model provided projections for 1965, 1980, and 2015 of population and employment parameters. The projections were for subareas only; therefore, other projection methods were used to provide the required county projections.

A dynamic model provides a flexible tool for analysis of economic variables. The project staff was able to study various assumptions regarding birth and death rates, migration, and unemployment rates within the model framework. Approximately 60 computer runs were made for the basin areas in an effort to study the effect of changes in the variables mentioned above. The growth rates and trends established in the model runs were used as a broad framework for the remainder of the projections presented in this report.

It must be remembered that any projection method is only as good as the assumptions behind it. In an effort to obtain reliable projections the MAC projections were compared with various national projections and projections made by the Alabama and Georgia Bureaus of Business Research.

DEMOGRAPHIC SECTOR

In the demographic sector projections for counties and subareas were made for the following classifications:

(1) Total Population
(2) Urban Population
(3) Rural Farm Population
(4) Rural Nonfarm Population
(5) White and Nonwhite Population
(6) Population Density

Total Population. The basic framework for the total population projections was the model concept discussed above. The Battelle model was used to project total population for each subarea for the years 1965, 1980, and 2015.

The model projections were then compared with other estimates such as 1965 Bureau of Business Research population projections and some adjustments were made in light of these comparisons.

County projections within each subarea were obtained by allocating the subarea projections to the counties in that particular area. The allocation was accomplished by projecting the historical trend of each county's per cent of the subarea population. The model subarea projections were used as a control; therefore, the sum of the county projections for a subarea will equal the subarea projection. also, the total basin projections were obtained by summing all subarea projections.

In projecting total population with the model, births, deaths, and migration were the major components used. In computing these components it was found that there is some variation between white and nonwhite birth and death rates in the basin area. Because of this variation several adjustments were made. First, the total birth rates by age groups were adjusted in accordance with the national birth rate trend factor. Although this adjustment did establish a trend in birth rates for the subarea it did not take into account the differences in white and nonwhite birth rates.

Generally nonwhite birth rates are higher in all age groups than white birth rates. Since the model uses birth rates for total population, our adjustment was made in the total birth rate based on the per cent nonwhite population in each age group and for each area.

The adjustment of the birth rates to take into account the influence of nonwhite population was made in the following manner:

(1) The change in the national trend was computed for the following periods:

    (a) 1960-1965
    (b) 1965-1980
    (c) 1980-2015

    1960 was used as the base year in the adjustment.

(2) An index of the 1960 per cent nonwhite population in each area was computed.

(3) The change in the national trend computed in (1) was divided by the index found in step (2).

(4) The adjustment computed in step (3) was then used to correct the birth rates for each subarea.

Death rates were adjusted in a manner similar to birth rates due to the white-nonwhite population mix. For use in the model, white and nonwhite death rates are combined for each age group. To reflect the white-nonwhite population mix in the death rate a weighted average was computed in the following manner:

$$1960\ SUBA_x\ \ DR_y = \frac{WDR_y\ (PW_y) + NWDR_y\ (PNW_y)}{PW_y + PNW_y}$$

y = Particular age group

$SUBA_x$ = MAC subarea

DR_y = Death rate for y age group

PNW_y = Per cent nonwhite population

PW_y = Per cent white population

$NWDR_y$ = Nonwhite death rate

This adjusted death rate for each subarea was then used in the demographic sector of the model.

Urban and Rural Population. In the projection of urban population, the total population projections were used to indicate the general population trends for each subarea.

The urban population projections were computed by projection of the historical urban percentage of total population. The projected urban percentages were then multiplied by total population to obtain urban population.

Rural population projections were then obtained as a residual of the urban projection process. In some instances the data for a particular area had to be adjusted based on judgement. For instance some areas which have been losing rural population at a rapid rate would have had very unrealistic rural population projections if the mathematical trends had been followed.

Rural farm population was obtained from the project staff at Auburn University which is responsible for the agricultural sector of the MAC Basin Project.

Rural nonfarm population was computed as a residual from rural and rural farm population. Due to the fact that the farm population projections were computed by another group, this was the only method available to produce consistent results for the subareas.

White-Nonwhite Population. Projected population according to race is a very important economic indicator for the MAC Basin area. To obtain these projections, historical trends for the per cent white and nonwhite were computed for each subarea. These percentage trends were projected for the years 1965, 1980, and 2015. The percentage projections were then multiplied by total population projections to obtain the white-nonwhite projections for each subarea.

County projections for urban, rural farm and nonfarm, white and nonwhite population were made by an allocation method using the subarea projections as control totals. The allocation method for these projections was the same as that discussed for total population.

Population density was also computed for each area in order to study population concentration and shifts during the projection period. Population density was computed by dividing the projected total population by the land area in square miles for each subarea.

EMPLOYMENT SECTOR

The basic framework for the employment sector projections was the Battelle model. A description of the employment relationships can be found in the model description of this report.

Basically, the model considered the interactions between population, relative wage, labor availability and the relative attractiveness of the region to determine the level of employment for each area. In the dynamic model future levels of employment were dependent upon changes in all of the factors discussed above. The model employment projections for the subareas were used as control totals to obtain county employment projections.

Labor Force. Total labor force projections for each subarea were obtained from the model output. These projections were made in the model by projections of labor force size in relation to the total population projections in the Demographic Sector of the model. National labor force trends were studied in determining trends for the MAC Basin that were used in the model. In general, it was assumed that labor force size in the Basin would follow the national projections.

Labor force projections for the counties within each subarea were determined through allocation methods with the subarea projections as control totals. The subarea labor force projections were allocated to the counties on the basis of the population in the county, at a given time, relative to that of the subarea. The relative position of each county was projected on the basis of historical trends, and these trends were used for computation of the final projections.

Total Employment. The total employment projections for each subarea were obtained from the model. The model projected labor force based on assumed trends in labor force participation rates. It was assumed that labor force participation rates for each subarea would move toward the national trends. The labor force projections and participation rates were then used to obtain total employment. There were feedback loops in the model which affected the level of employment. Variables describing the attractiveness of the region, which included transportation, raw material and labor availability, also had some effect on employment.

Changes in levels of employment were fed back into the Demographic Sector for use in determining population. Thus the model provided a tool for the dynamic analysis of the interrelationship of population and employment that would have been impossible through the use of historical projections alone.

County projections for employment were again produced through the use of the subarea projections as control totals and allocating these totals to the county based on the relative position of the county in the subarea.

Unemployment. Unemployment projections for the subareas and counties were obtained by taking the difference in the labor force projections and the total employment projections. The assumption of an unemployment rate of 4 to 6 per cent over the projection period was kept in mind in both labor force and employment projections.

Employment by SIC Groups. The model output gave projections for total employment and a breakdown for household serving and business serving employment. A more detailed breakdown was needed, and therefore projections outside the model were made. Ten SIC groups were used in the detailed projections and are as follows:

Agriculture
Mining
Contract Construction
Manufacturing
Transportation, Communication and Utilities
Wholesale and Retail Trade
Finance, Insurance and Real Estate
Services
Government
Nonclassifiable Establishments

In order to obtain the detailed county projections the total employment projections for each county were used as control totals.

To study the relative position of the above categories, historical census data were studied and trends for each classification were projected.

The industrial mix of each county was studied, and any knowledge of new industry location was taken into account in determining the final projections. Finally, these projections were compared with the University of Alabama Bureau of Business Research county estimates in order to check out any unrealistic values.

Employment in Heavy Water Using Industries. Employment was projected for the following SIC's considered heavy water users by the Health, Education and Welfare contract for the MAC Basin Project:

Division B. Mining

Principal water using industries:
12. Bituminous coal and lignite mining.
14. Mining and quarrying of nonmetallic minerals, except fuels.

Division D. Manufacturing

Principal water using industries:
20. Food and kindred products.
22. Textile mill products.
26. Paper and allied products.
28. Chemicals and allied products
29. Petroleum and coal products.
33. Primary metal products.

Division F. Transportation, communication, electric, gas and sanitary services.

Principal water using industries:
44. Water transportation.
49. Electric (including electric power generation but excluding water supply and sanitary services.)

Due to the lack of data for these groups in some counties, projection of employment in heavy water using industries was limited to the subareas. These projections were made through the extension of 1960 employment levels based on assumed growth rates for these industries. Also these projections were adjusted based on the heavy water using employment relative to total employment trends in the subarea.

Heavy water using industry employment for the basin was obtained by summing the projections for all subareas.

INCOME SECTOR

Projection of income was not included in the model; therefore, this sector was projected outside the model. However, the income estimates are indirectly related to the model through the use of employment trends for determining future income levels. All of the income projections are in terms of current dollars.

Total Personal Income. Personal income projections were based on historical data from the census and various 1965 estimates of personal income by county that were available.

The basic personal income projections were made at the county level. Personal income was correlated with employment levels, and income was projected following the projected employment trend for each county. The employment mix for each county was taken into consideration in determining the relationship between income and employment.

Some average wages for industry groups were used when they were available, but this information was not consistent for all counties.

Subarea projections for total personal income were obtained through the summation of county projections for each subarea, and likewise, the basin projections through a summation of the subarea totals. These subarea projections were compared with national projections and it was assumed that income levels in the MAC Basin would approach those on the national level.

Per Capita Income. Per capita income projections are a product of other projections. The total personal income projection for each county was divided by the total population projection in that county in order to obtain the projected per capita income. National trends for per capita income were checked, and also county historical per capita income data were used to check the per capita income projections that were obtained in an indirect manner. In several areas the per capita projections were revised in view of the historical data, and then the total personal income projections for that particular area were adjusted accordingly.

Disposable Personal Income. The most difficult income projection was that of disposable personal income. County projections are required in the contract, but no data for DPI exist at the county level. For this reason DPI projections had to be estimated using the state DPI as a starting point.

In order to develop a procedure to estimate DPI for each county, it was assumed that the level of DPI would be related to the median income in the county. For example, the higher the median income, the higher tax rate the county will have, and therefore, the DPI as a per cent of total income will decrease. On the other hand in counties with low median income, taxes will take a smaller portion of income, thus the DPI expressed as a per cent of total income will be higher.

The procedure for computing DPI is as follows:

(1) compute a median index for the counties considered using 1960 median income for the state as a base. (See Table I for examples of all computations.)

(2) Adjust the state DPI percentage (1960 for Alabama = .89317) based on the relative position of individual counties in the index computed in step (1).

(3) As an example:

    (1) Check the range of the median income index on either side of the base. The range will help determine the extent of adjustment which will be made in the state DPI in order to obtain DPI for a given county.

    (2) This procedure is based on the assumption that counties with median income below the state average should have the % DPI adjusted upward and vice versa. To make this adjustment judgement is used to determine the upper and lower limits.

        (A) The range of the index for Alabama counties for 1960 was .35 to 1.30. To compute the per cent adjustment for county I (Table I), take the difference in the index for county I (equal to 1.21) and the base (1.21 - 1.00 = .21).

        (B) This difference is then compared to the upper range of the index (1.3 - 1.00 = .3). This ratio is .21/.3 = .7.

(C) This factor (%) is multiplied by the % limit which is arbitrarily set as mentioned above. In this case .7 x 3% = 2.1%.

Note: It was decided to set a limit of 3% for the upper side of the index and 6% for the lower side.

(4) This DPI % adjustment is then added or subtracted to the state DPI %. In this example this would be .89317-.0210 which gives .87217 for the adjusted DPI per cent for county I.

(5) This adjusted DPI % is then multiplied by Personal Income for individual counties for a given year to obtain an estimated DPI for each county.

TABLE I

County	1960 Median Income ($)	Median Income Index 3937=100	DPI % ADJ.	Adjusted DPI %	1960 Personal Income ($1,000)	Estimated DPI ($1,000)
I	4,777	1.21	-2.10	.87217	306,299	267,145
II	3,835	.97	+0.27	.89587	57,864	51,839
III	5,103	1.29	-2.89	.86427	1,384,194	1,196,317
IV	2,923	.74	+2.40	.91717	9,661	8,860

After obtaining estimated 1960 DPI for each county, the adjusted DPI % was projected for each county in relation to the projected total personal income, and the projected DPI % was multiplied by projected total personal income to obtain projected disposable personal income for each county.

Income by Major Components. The next required income projected was a breakdown of total personal income by major components. The following breakdown of total personal income was used in this section:

Wage & Salary
Other Labor Income

Proprietor's Income
  Farm
  Nonfarm
Property Income
Transfer Payments
Less: Personal Contributions
  for Social Insurance.

In each subarea the projected total personal income was broken down into the above categories and projected for 1965, 1980, and 2015. In order to project the various segments, the relative position of that segment in each subarea was projected. The total personal income projections were used as control totals for all areas. These projections were made for the subareas only due to the lack of consistent data at the county level. The major weakness of the county data was the problem of disclosure in some of the smaller counties.

Wage and Salary Disbursements. The wage and salary section of the projections discussed above was broken down into 10 groups as follows:

Agriculture
Mining
Contract Construction
Manufacturing
Transportation
Wholesale and Retail Trade
Finance and Insurance
Services
Government
Nonclassifiable

Again, these projections were only made for the subareas due to the inadequacy of the county data. The nonclassifiable category was included as a residual due to the fact that the wage and salary projections were used as control totals for the detailed breakdown.

In projecting these categories the trend for income and for wage and salary disbursements was studied for each subarea. Also the relative importance of each category for each area was considered, and a trend of the relative portion of each category was projected to 2015. These trends were based on historical data and current knowledge of the categories for each area. In general, it was assumed that the services and government sectors would gain importance in relation to the other categories.

NUMBER OF HOUSEHOLDS

For the projections of the number of households, several breakdowns were used for each county in each subarea. The following breakdowns were used to project the number of households for 1965, 1980, and 2015.

- (1) Population per Household
    - (A) Total
    - (B) Urban
    - (C) Rural
        - (1) Farm
        - (2) Nonfarm
- (2) Total number of Households
    - (A) Total number of urban households
    - (B) Total number of rural households
        - (1) Rural farm households
        - (2) Rural nonfarm households

The projections of population per household for each county were made through use of historical trends for each of the breakdowns. An adjustment had to be made in determining an average population per household due to the white-nonwhite mix in each county. In general it was found that the nonwhite population per household tended to be higher than white population per household. This problem was accounted for by adjusting the average population per household by the current white-nonwhite ratio and also by the white-nonwhite population ratio for the projected years.

Also, the white and nonwhite population was correlated to historical population per household in order to estimate the size of the above adjustments. In making the household projections it can be assumed that the urban population per household would continue to decrease slightly and also remain below the rural population per household.

After obtaining population per household projections for each county the number of households for each county was found by dividing the projected population for each breakdown by the projected population per household. As an example:

$$\begin{array}{c}\text{Total number of urban}\\ \text{households for}\\ \text{County A in 1980}\end{array} = \frac{\text{Total urban population for County A in 1980}}{\text{Urban population per household in 1980}}$$

After obtaining the household projections for counties in the above manner, the subarea and basin projections were obtained by summing the county projections.

VALUE ADDED BY MANUFACTURE

A projection of value added by manufacture was needed to obtain some measure of productivity trends in the basin area. The measurement of productivity is one of the most controversial areas in economic analysis and presented the most difficult problem for the basin projections.

An effort was made to use value of shipments in addition to value added data, but it was found that the value of shipments data was not complete enough for use in measuring productivity.

The initial step in projecting productivity was to study the national trends and projections for Gross National Product and Value Added by Manufacture. It was assumed that trends in the basin area would approach the level of the national trends during the projection period.

The projection of value added could be made only for the subareas and the basin due to inadequate data at the county level.

In order to measure the change in productivity over the projection period, an index was constructed using the relationship between income and employment. It was assumed that the projected income in the manufacturing sector of each subarea would be a measure of output for any given time period. Also, the level of employment at that time would be an estimate of input for manufacturing. By dividing the income in manufacturing for any given period by the manufacturing employment for that period, an estimate of income per employee was obtained. Then using 1960 income per employee as a base, an index was constructed. An example of this index and the value added estimates is presented below, and the detailed tables are presented in Appendix C of this report.

AREA I	1960	1965	1980	2015
Index of productivity	100.00	113.67	172.71	289.99
Value added by mfr. ($1,000)	55,914	58,738	89,250	149,855

It was assumed that the change in the index of income per employee in manufacturing would indicate the change in productivity in the projection period. This index as compared with the national projections and some corrections were made based on the assumption that the basin productivity would approach the national level.

After computing the index of productivity for each subarea, value added was computed by multiplying the index value by the 1963 Value Added by Manufacture figures.

This index was also computed for other categories such as agriculture, transportation, services and government but was not used in projecting value added since this measure is very difficult to define outside the manufacturing sector.

CONCLUSION

In making all of the various required projections, the interaction of all of the economic variables was observed. The use of a dynamic model enabled the project staff to study various interrelationships and thus set up a model which would represent the "real world" of the basin area. The use of the model also made possible the development of secondary variables by methods other than historical projections.

Although the model could not be used for some areas such as income and productivity, it is hoped that future development of the model will include all relevant areas which must be considered for the economic development of an area.

It should be remembered that economic projections are only as valid as the assumptions behind them. It is hoped that the economic assumptions behind the MAC River Basin projections are realistic and valid for future years to the extent that these projections provide a useful tool for planning and development.

CHAPTER V

A GENERAL DESCRIPTION OF THE DYNAMIC MATHEMATICAL MODEL USED TO PROJECT THE ECONOMY OF THE MOBILE-ALABAMA-COOSA RIVER BASIN

Investigation and testing of various methods of projecting a region's economic condition for fifty or more years into the future indicated that a mathematical model would most nearly depict the changes likely to occur during the projection period. The MACR Project Staff, with the approval of the U. S. Government contracting officer, decided to adapt to the Mobile-Alabama-Coosa River Basin a model developed by Battelle Memorial Institute of Columbus, Ohio, for the Susquehanna River Basin. (For a more detailed description of the model's relationships see the copies of Battelle's model submitted with the material supporting this report.)

A mathematical model has many advantages over other projection procedures. Since the model is made up of explicit equations there can be few questions with regard to how the projections are derived.

Mathematical models are easily adapted for use on a computer. Computational problems are virtually eliminated; therefore, the model can be used to test policy changes with very little effort on the part of the research staff.

Mathematical models are dynamic and are therefore more representative of changing regional economies than are more conventional methods of projection.

This report briefly describes the model constructed for the Mobile-Alabama-Coosa River Basin. The MACR model is written in FORTRAN IV and was run on the Univac 1107 computer at the University of Alabama Research Institute in Huntsville, Alabama.

THE MODEL

This section of the report describes the nature of the dynamic mathematical model of the MAC River Basin.

Model Structure

The model is divided into sections or compartments which correspond to the natural divisions of the Basin's economy.

There are two primary divisions. First, the Basin is divided into economic subregions, and then the economy of each subregion is divided into groups of interrelated variables involving the same general topics, for instance, employment, population, electric power, etc.

In the MACR study, only the population and employment subsectors of the model were needed. The water and electric power subsectors of the Battelle model were not removed, but their effect on the demographic and employment subsectors was nullified by using zeros for input data.

Subregionalization

Study of the MACR Basin indicated that economic activity is centered around the major towns either in or adjacent to the Basin area. It was decided to divide the Basin into six subregions, each having as its economic center an SMSA or a large town. Although the Mobile, Alabama, Birmingham, Alabama, and Atlanta, Georgia, SMSA's are not included in the MAC Basin, they were included as the focal cities for Areas 1, 4, and 6, respectively.

The number of counties in the subregions varies from three to 18. Investigation of trade and commuting patterns indicated that the six selected subregions were relatively independent of each other. The simulation is run once for each subregion, and then the Basin totals are summed outside the model.

The following is a list of the subregions used in the MACR model and the counties which comprise each subregion.

Area 1

Mobile, Alabama
Baldwin, Alabama
Monroe, Alabama

Area 2

Wilcox, Alabama
Perry, Alabama
Dallas, Alabama

Area 3

Autauga, Alabama
Lowndes, Alabama
Montgomery, Alabama
Macon, Alabama
Lee, Alabama
Tallapoosa, Alabama
Elmore, Alabama
Coosa, Alabama

Area 4

Chilton, Alabama
Bibb, Alabama
Shelby, Alabama
Jefferson, Alabama
Walker, Alabama
Blount, Alabama
St. Clair, Alabama

Area 5

Talladega, Alabama
Clay, Alabama
Randolph, Alabama
Cleburne, Alabama
Calhoun, Alabama
Etowah, Alabama
Cherokee, Alabama

Area 6

Chattooga, Georgia
Whitfield, Georgia
Murray, Georgia
Gilmer, Georgia
Dawson, Georgia
Pickens, Georgia
Gordon, Georgia
Floyd, Georgia
Bartow, Georgia
Cherokee, Georgia
Polk, Georgia
Haralson, Georgia
Paulding, Georgia
Cobb, Georgia
Fulton, Georgia
Clayton, Georgia
Dekalb, Georgia
Gwinnett, Georgia

MODEL SUBSECTORS

Each of the subregions in the Basin has been described by a series of equations that are divided into subsectors. A subsector is defined as a group of equations relating to the same or similar factors. In each subsector are equations that tie that subsector to other subsectors.

Generally, the MACR model may be divided into two groups of variables forming major subsectors, demographic and employment. Each of these major subsectors is in turn divided into minor subsectors. For instance, the demographic subsector may be divided into the minor subsectors, births, deaths and migration.

Appendix A lists all the equations in the demographic and employment subsectors in the order of their occurrence and defines the variables appearing in each equation. For the sake of brevity, only arithmetic statements are listed. A complete listing of the program can be found in the supporting material submitted with this report.

The following sections describe the major subsectors, some of their minor subsectors, and important interactions.

Demographic Subsector

The basic function of the demographic subsector is to account for the changing characteristics of the population. This is done by accounting for increases and decreases in various age classes of the population over time.

Population increases may come from either births or immigration. Decreases are caused by deaths or out-migration. Therefore, the level of population at any given time depends on the level of population in the base year (1960) and the births, deaths and migration occurring since the base year.

Births. Births are not only affected by the absolute size of the population but by the age distribution of this population. A population structure with a high number of people in the fertile age groups will have a higher over-all birth rate than one in which the older or very young groups predominate. For this reason, it is not only desirable for the model to maintain a count on the total level of population, but to break this population into groups with relatively homogeneous birth rates.

In order to project population and births over time, it is desirable to have an indication of birth rates and their trends. Investigation show that birth rates in the MACR Basin are generally higher than the national average, except in Area 6. An adjustment was made in the total birth rate based on the per cent of nonwhite population in each age group for each area.

Birth rates in the nation are expected to be lower as time passes, and birth rates in the MACR Basin are expected to become more nearly like those in the rest of the nation. This is expected due to the continued out-migration of the nonwhite population and other sociological changes. A trend is built into the model to lower the Basin's birth rates over time so that they will approach the national average.

Use of the model - computer simulation - demonstrates that the demographic subsector is very sensitive to changes in the birth rate. A small shift in the birth rate has a significant effect on estimates of the future population and the behavior of the economy.

Deaths. Similar to births, the number of deaths depends not only upon the size of the population but its distribution by age class. Again it is necessary to split the population into age groups to get an accurate count of deaths.

Death rates are projected to decrease slightly in each of the age classes over time. Area 2 had significantly higher death rates than the other areas and was therefore treated separately in establishing death rate trends over time.

Long run projections of population and economic conditions are not nearly so sensitive to changes in death rates as to changes in birth rates.

Migration. Migration into and out of the MACR Basin seems to be dictated by the availability of higher-paying jobs rather than by the unemployment rate. Statistical analysis indicated a valid relationship between migration and relative wage and none between migration and unemployment. When the relative wage in an area falls, significant out-migration takes place. Conversely, when the relative wage is high, in-migration occurs. The statistical analysis of the migration-relative wage relationship was performed by age class since young adults tend to migrate in response to relative wage changes more quickly than other age classes. This is a major difference in the MACR model and Battelle's Susquehanna model.

Age Classes. The importance of dividing population into age classes has been mentioned in relation to births, deaths and migration. Six age classes were selected for the MACR model: 0 to 13, 14 to 19, 20 to 29, 30 to 44, 45 to 64, and 65 and over.

Major Interrelationship - Demographic Subsector. The interrelationship of major importance between the demographic subsector and other subsectors (Figure) is the relationship to employment. A rise in population will produce a rise in the labor force. A rise in the labor force with no subsequent increase in employment will, of course, raise the unemployment rate. Unemployment affects relative wage which affects migration which in turn affects population which lowers the labor force. This is an illustration of one of the tight "feedback loops" in the model.

Employment Subsector.

A major determinate of the growth of a region is job opportunities. In order to study these opportunities, it is necessary to divide economic activity in the region into a number of categories. The first, and perhaps most import, of these is the so-called "export" industries. These industries serve markets that are essentially outside the subregion in which they exist, and to a large extent outside the Basin itself. They have been defined as agriculture, export mining, export government and education, and export manufacturing.

Agriculture and Export Mining. It was felt that development in agriculture and export mining is dependent on a region's natural endowment. Therefore, their employment was projected outside the model.

Export Government and Education. These activities locate and grow as a result of noneconomic influences beyond the scope of the model. Therefore, these activities also are projected independently and inserted into the model exogenously.

Export Manufacturing. Generally, the growth or decline of the export manufacturing industries is dependent on many more factors than are the above-mentioned categories. Essentially, this growth depends upon the attractiveness of the region for these manufacturing activities as opposed to the attractiveness of other parts of the county where they might locate.

The initial growth rate of these industries is based upon market-area projections of labor employment in the industry group, and the attractiveness of the various subregions in the MACR Basin is then used to modify the basic rates. The attractiveness of each subregion is considered separately and is updated during each time period by the model.

Attractiveness is related to two factors. The first is relative wage, that is, the ratio of the wages in the subregion to those paid nationally. The second is transportation factors affecting industry, which are broken into two part, access to raw materials and access to markets.

The reason for using wages and transportation costs is that a cost analysis of a variety of industries illustrated that these two factors were the only major cost items likely to change by location. Other costs, for the most part, are apt to be either minor, temporary or insensitive to location.

The transportation factors are considered fixed over time. This is based on the assumption that MACR Basin transportation advantages and disadvantages relative to the rest of the country will not change significantly.

Relative wage, on the other hand, is varied by the model itself, dependent on the unemployment rate. High unemployment rates tend to drive the relative wage down, while low unemployment rates tend to boost the relative wage.

The relative wage, the transportation cost factors, and those cost factors not sensitive to location are then added to derive a total-cost index for the region. Basic growth rates projected for these industries are then modified by the cost attractiveness of the region as provided by the model. If costs are lower than average for the market area being served, the rate of growth is adjusted upward. Conversely, higher costs adjust the rate downward.

All export manufacturing industries are not treated identically. They were instead cross-classified by different cost factors. Six categories were established. Each of these responds differently to cost changes in the model. Following is a list of the six industry groups used in the MACR model showing the two-digit SIC's included in each.

GROUP I - Consumer Nondurables

20 Food and Kindred Products
21 Tobacco Manufacturing
22 Textile Mill Products

GROUP II - Household Fabricators

23 Apparel
25 Furniture and Fixtures
31 Leather and Leather Products
39 Miscellaneous Manufacturing

GROUP III - Resource-Oriented Processors

24 Lumber and Wood Products
26 Paper and Allied Products
32 Stone, Clay and Glass Products

GROUP IV - Primary Metals

33 Primary Metals

GROUP V - Chemicals

28 Chemicals and Allied Products
29 Petroleum and Coal Products

GROUP VI - Export Manufacturing

27	Printing and Publishing
30	Rubber and Miscellaneous Plastics
34	Fabricated Metal Products
35	Machinery, Except Electrical
36	Electrical Machinery
37	Transportation Equipment
38	Instruments, Professional and Scientific

Business-Serving Industries. The first group of local-serving industries is the business-serving group. It includes those firms whose function is to serve the needs of other local area firms. Statistical analysis indicates that employment in the business-serving industries is directly related to total employment minus business-serving employment. Therefore, the growth or decline in the business-serving industries is related in the model to a summation of jobs in other economic activities.

Listed here are the SIC categories considered to be business-serving. *

14	Mining and Quarrying of nonmetallic minerals, except fuels
15	Building construction
16	Highway and street construction
17	Construction - special trade contractors
271	Newspapers
275	Commercial printing
278	Bookbinding and related industries
279	Service Industries for printing
2951	Paving mixtures and blocks
324	Hydraulic cement
325	Structural clay products
327	Concrete, gypsum, and plaster products
3271,-2, -3,-4	Concrete and lime
347	Coating, engraving, and allied services
40	Railroad transportation
41	Local and suburban transit
42	Warehousing and motor freight transportation
44	Water transportation
45	Transportation by air
47	Transportation services
48	Communication
49	Electric, gas, and sanitary services

*The manufacturing SIC's (20-39) are subtracted from the two-digit export-manufacturing totals.

Household-Serving Industries. The second local-serving industry category is household-serving industry. This category provides services to households. Statistical analysis relates jobs in household-serving industries to total population. The model determines household-serving employment as a function of subregional population.

Those industries classified as household-serving appear in the list below. *

202	Dairy products
2051	Bread and other bakery products
2071	Candy and other confectionery products
2511	Wood household furniture, except upholstered
2519	Household furniture, n.e.c.
271	Newspapers
323	Glass products of purchased glass
3732	Boat building and repair
3981, 3987, 3992, 3993, 3995, 3999	Miscellaneous manufacturing industries
50	Wholesale trade
52-59	Retail trade
60	Banking
61	Credit agencies
62	Security and commodity brokers
63-67	Insurance carriers and real estate
70	Hotels, rooming houses, camps, etc.
72	Personal service
73	Miscellaneous business services
75	Automobile repairs
76	Miscellaneous repairs
78	Motion picture
79	Amusement and recreation services (subtract water-based recreation)
80	Medical and other health services
81	Legal services
84	Museums, art galleries, etc.
86	Nonprofit membership organizations
88	Private households
89	Miscellaneous services

*The manufacturing SIC's (20-39) are subtracted from the two-digit export-manufacturing totals.

Major Interrelationship - Employment Subsector. The major interrelationship of the employment subsector to the demographic subsector is through the labor-force and unemployment rates. A rise in jobs drops unemployment, which raises relative wage and slows out-migration.

Within the employment subsector, a rise in the number of jobs will reduce unemployment rates, drive relative wage up, and reduce the attractiveness of the subregion. Conversely, a decline in the number of jobs will raise unemployment rates, reduce relative wage and increase subregional attractiveness.

The outcome of the total effect of a rise or fall in number of jobs depends on the complex feedbacks between labor force, unemployment rates, migration, and total population, as well as the relative attractiveness of industry as affected through relative wage. Obviously, such a maze of interactions requires analysis by means of a dynamic model.

Water and Electric Power Subsectors.

As mentioned before, Battelle's Susquehanna Model has a Water Subsector and an Electric Power Subsector. Although these subsectors have been built into the MACR model, their effect has been "turned off" by using zeroes as input data for the equations in these subsectors.

APPENDIX A

MODEL EQUATIONS

APPENDIX A

The statements documented in this appendix are the equations which actually perform the calculations within the model. Only arithmetic statements are included. A complete listing of the program, including Dimension, Control, Print, and Format statements, etc., is included with the supporting material submitted with this report.

Generally two types of equations are used. The first is a simple arithmetic statement such as:

```
POPD = CHLD + TND + YAD + PMD + MAD + OLD
```

where

POPD = Population (men)
CHLD = Children, ages 0 to 13 (men)
TND = Teenagers, ages 14 to 19 (men)
YAD = Young adults, ages 20 to 29 (men)
PMD = Prime aged, ages 30 to 44 (men)
MAD = Middle aged, ages 45 to 64 (men)
OLD = Oldsters, over 65 (men)

This equation calculates the total population of the subregion by summing all of its components.

The second equation form is:

```
TDROD = TABHL (TTDOD, TIME, 0.,60.,60.)
```

where

TDROD = Trend in death rate of oldsters (D)
TTDOD = Table for TDROD (D)
TIME = Time (yr)

This form makes use of one of the two functions (TABLE AND TABHL) written into the program to provide a table look-up device. In this particular case, the trend in the death rate of oldsters is a function of time from the 0th year (1960) to the 60th year. The first of the three numbers marks the first point in time, the second marks the end point in time, and the third indicates the interval between values in the table.

This model computes at quarterly intervals. In this study, projections were desired for every year from 0 through 60; however, the model is capable of projecting for every quarter if necessary.

POPD =CHLD+TND+YAD+PMD+MAD+OLD

POPD = Population (men)
CHLD = Children, ages 0 to 13 (men)
TND = Teenagers, ages 14 to 19 (men)
YAD = Young adults, ages 20 to 29 (men)
PMD = Prime ages, ages 30 to 44 (men)
MAD = Middle ages, ages 45 to 64 (men)
OLD = Oldsters, ages 65 and over (men)

WGEI =TABLE(TGEI,TIME,0.,60.,60.)

WGEI = Workers in Government and Education (men)
TGEI = Table of workers in government and education
TIME = Time (yr)

DWHI = TABLE(TDWHI,POPD,2.5E4,3.1E6,3.075E6)

DWHI = Desired workers in household serving industries (men)
TDWHI = Table of desired workers in household serving industries
POPD = Population (men)

TDROD = TABHL(TTDOD,TIME,0.,60.,60.)

TDROD = Trend in death rate of oldsters (D)
TTDOD = Table for Trend in death rate of oldsters
TIME = Time (yr)

TDRCD = TABHL(TTDCD,TIME,0.,60.,60.)

TDRCD = Trend in death rate of children (D)
TTDCD = Table for trend in death rate of children
TIME = Time (yr)

TDRTD = TABHL(TTDTD,TIME,0.,60.,60.)

TDRTD = Trend in death rate of teenagers (D)
TTDTD = Table for trend in death rate of teenagers
TIME = Time (yr)

TDRYD = TABHL(TTDYD,TIME,0.,60.,60.)

TDRYD = Trend in death rate of young adults (D)
TTDYD = Table for trend in death rate of young adults
TIME = Time (yr)

TDRPD = TABHL(TTDPD,TIME,0.,60.,60.)

TDRPD = Trend in death rate of prime aged (D)
TTDPD = Table for trend in death rate of prime aged
TIME = Time (yr)

TDRMD = TABHL(TTDMD,TIME,0.,60.,60.)

TDRMD = Trend in death rate of middle aged (D)
TTDMD = Table for trend in death rate of middle aged
TIME = Time (yr)

TDRND = TABHL(TTDND,TIME,0.,60.,60.)

TDRND = Trend in death rate percentage of new children (D)
TTDND = Table for trend in death rate percentage of new children
TIME = Time (yr)

BRTND = TABLE(TBRTD,TIME,0.,60.,60.)

BRTND = Birth rate of teenagers (men/man/yr)
TBRTD = Table for birth rate of teenagers
TIME = Time (yr)

BRYAD = TABLE(TBRYD,TIME,0.,60.,60.)

BRYAD = Birth rate of young adults (men/man/yr)
TBRYD = Table for birth rate of young adults
TIME = Time (yr)

BRPMD = TABLE(TBRPD,TIME,0.,60.,60.)

BRPMD = Birth rate of prime adults (men/man/yr)
TBRPD = Table for birth rate of prime adults
TIME = Time (yr)

BRMAD = TABLE(TBRMD,TIME,0.,60.,60.)

BRMAD = Birth rate of middle aged (men/man/yr)
TBRMD = Table for birth rate of middle aged
TIME = Time (yr)

TMOLD = TABHL(TTMOD,TIME,0.,60.,60.)

TMOLD = Trend in migration of oldsters (D)
TTMOD = Table for trend in migration of oldsters
TIME = Time (yr)

TETND = TABLE(TTETD,TIME,0.,60.,60.)

TETND = Trend in education of Teens (D)
TTETD = Table for trend in education of teens
TIME = Time (yr)

PCWA = TABLE(TPCWA,TIME,0.,60.,10.)

PCWA = Percent change of workers in agriculture (1/yr)
TPCWA = Table for percent change of workers in agriculture
TIME = Time (yr)

WXMI = TABLE(TWMI,TIME,0.,60.,5.)

WXMI = Workers in export mining (men)
TWMI = Table of workers in export mining
TIME = Time (yr)

FPWA = PPFWW*WA

FPWA = Farm population (men)
PPFWW = Farm dwellers per farm worker
WA = Workers in agriculture (men)

WEIL = WBSI+WHSI+WWR+WGEI

WEIL = Partial summation of workers employed (men)
WBSI = Workers in business serving industries (men)
WHSI = Workers in household serving industries (men)
WWR = Workers in water based recreation (men)
WGEI = Workers in Government and education (men)

TWEL = WICND+WIHFB+WIROP+WIPRM+WIEMF+WICHM+WXMI+WWCI+WA+WEIL

TWEL = Total workers employed (men)
WICND = Workers in consumer nondurables (men)
WIHFB = Workers in household fabricating (men)
WIROP = Workers in resource oriented processors (men)
WIPRM = Workers in primary metals (men)
WIEMF = Workers in export manufacturing (men)
WICHM = Workers in chemicals (men)
WXMI = Workers in export mining (men)
WWCI = Workers in water works construction (men)
WA = Workers in agriculture (men)
WEIL = Partial summation of workers employed (men)

TWBI = TWEL-WBSI

TWBI = Total workers in businesses served (men)
TWEL = Total workers employed (men)
WBSI = Workers in business serving industries (men)

DWBI = TABLE(TDWBI,TWBI,20.E3,2.E6,1.98E6)

DWBI = Desired workers in business serving industries (men)
TDWBI = Table of desired workers in business serving industries
TWBI = Total workers in businesses served (men)

LFIL = FYLL*YAD+FPLL*PMD+FMLL*MAD+FOLL*OLD

LFIL = Partial summation of labor force (men)
FYLL = Fraction of young adults in labor force (D)
YAD = Young adults, ages 20 to 29 (men)
FPLL = Fraction of prime aged in labor force (D)
PMD = Prime ages, ages 30 to 44 (men)
FMLL = Fraction of middle aged in labor force (D)
MAD = Middle aged, ages 45 to 64 (men)
FOLL = Fraction of oldsters in labor force (D)
OLD = Oldsters, 65 and over (men)

TLFL = LFIL+FTLL*TND

TLFL = Total labor force (men)
LFIL = Partial summation of labor force (men)
FTLL = Fraction of teenagers in labor force (D)
TND = Teenagers, ages 14 to 19 (men)

UL = TLFL-TWEL

UL = Number unemployed (men)
TLFL = Total labor force (men)
TWEL = Total workers employed (men)

LURL = UL/TLFL

LURL = Local unemployment rate (D)
UL = Number unemployed (men)
TLFL = Total labor force (men)

TWUL = TLFL-TWEL

TWUL = Total workers unemployed (men)
TLFL = Total labor force (men)
TWEL = Total workers employed (men)

DURL = LURL-NURL

DURL = Difference between local and national unemployment rates (D)
LURL = Local unemployment rate (D)
NURL = National unemployment rate (D)

SNURL = NURL

SNURL = Smoothed national unemployment rate (D)
NURL = National unemployment rate (D)

IBHI = DWHI-WHSI

IBHI = Initial bias in desired workers in household serving industries (men)
DWHI = Desired workers in household serving industries (men)
WHSI = Workers in household serving industries (men)

IBBI = DWBI-WBSI

IBBI = Initial bias in desired workers in business serving industries (men)
DWBI = Desired workers in business serving industries (men)
WBSI = Workers in business serving industries (men)

SLUL = LURL

SLUL = Smoothed local unemployment rate (D)
LURL = Local unemployment rate (D)

SKLD = IASD*(TND+YAD+PMD+MAD)

SKLD = Total skill level (man-yrs of education)
IASD = Initial average skill level (man-yrs of education)
TND = Teenagers, ages 14 to 19 (men)
YAD = Young adults, ages 20 to 29 (men)
PMD = Prime ages, ages 30 to 44 (men)
MAD = Middle aged, ages 45 to 64 (men)

DUDD = DURL

DUDD = Difference in unemployment delayed (D)
DURL = Difference between local and national unemployment rates (D)

DOLD = DROLD*TDROD*OLD

DOLD = Deaths of oldsters (men/yr)
DROLD = Death rate of oldsters (men/man/yr)
TDROD = Trend in death rate of oldsters (D)
OLD = Oldsters, ages 65 and over (men)

DCHD = DRCHD*TDRCD*CHLD

DCHD = Deaths of children (men/yr)
DRCHD = Death rate of children (men/man/yr)
TDRCD = Trend in death rate of children (D)
CHLD = Children, ages 0 to 13 (men)

DTND = DRTND*TDRTD*TND

DTND = Deaths of teenagers (men/yr)
DRTND = Death rate for teenagers (men/man/yr)
TDRTD = Trend in death rate of teenagers (D)
TND = Teenagers, ages 14 to 19 (men)

DYAD = DRYAD*TDRYD*YAD

DYAD = Deaths of young adults (men/yr)
DRYAD = Death rate of young adults (men/man/yr)
TDRYD = Trend in death rate of young adults (D)
YAD = Young adults, ages 20 to 29 (men)

DPMD = DRPMD*TDRPD*PMD

DPMD = Deaths of prime ages (men/yr)
DRPMD = Death rate of prime aged (men/man/yr)
TDRPD = Trend in death rate of prime aged (D)
PMD = Prime ages, ages 25 to 44 (men)

DMAD = DRMAD*TDRMD*MAD

DMAD = Deaths of middle ages (men/yr)
DRMAD = Death rate of middle aged (men/man/yr)
TDRMD = Trend in death rate of middle aged (D)
MAD = Middle aged, ages 45 to 64 (men)

DTHD = DCHD+DTND+DYAD+DPMD+DMAD+DOLD

DTHD = Deaths (men/yr)
DCHD = Deaths of children (men/yr)
DTND = Deaths of teenagers (men/yr)
DYAD = Deaths of young adults (men/yr)
DPMD = Deaths of prime aged (men/yr)
DMAD = Deaths of middle aged (men/yr)
DOLD = Deaths of oldsters (men/yr)

ETND = BETND*TETND

ETND = Education of teenagers (man-yrs/man/yr)
BETND = Basic education of teenagers
TETND = Trend in education of teens (D)

GCHD = CHLD/DCPD

GCHD = Grown children (men/yr)
CHLD = Children, ages 0 to 13 (men)
DCPD = Duration of childhood period (yrs)

GTND = TND/DTPD

GTND = Grown Teenagers (men/yr)
TND = Teenagers, ages 14 to 19 (men)
DTPD = Duration of teenage period (yrs)

GYAD = YAD/DYPD

GYAD = Grown young adults (men/yr)
YAD = Young adults, ages 20 to 29 (men)
DYPD = Duration of young adult period (yrs)

GPMD = PMD/DPPD

GPMD = Grown prime aged (men/yr)
PMD = Prime ages, ages 30 to 44 (men)
DPPD = Duration of prime age period (yrs)

GMAD = MAD/DMPD

GMAD = Grown middle aged (men/yr)
MAD = Middle aged, ages 45 to 64 (men)
DMPD = Duration of middle age period (yrs)

LBCD = BRTND*TND+BRYAD*YAD+BRPMD*PMD+BRMAD*MAD

LBCD = Live births of children (men/yr)
BRTND = Birth rate of teenagers (men/man/yr)
TND = Teenagers, ages 14 to 19 (men)
BRYAD = Birth rate of young adults (men/man/yr)
YAD = Young adults, ages 20 to 29 (men)
BRPMD = Birth rate of prime adults (men/man/yr)
PMD = Prime ages, ages 30 to 44 (men)
BRMAD = Birth rate of middle aged (men/man/yr)
MAD = Middle ages, ages 45 to 64 (men)

DNCD = DRNCD*TDRND*LBCD

DNCD = Deaths of new children (men/yr)
DRNCD = Death rate percentage of new children (D)
TDRND = Trend in death rate percentage of new children (D)
LBCD = Live births of children (men/yr)

BCHD = LBCD-DNCD

BCHD = Births of children (men/yr)
LBCD = Live births of children (men/yr)
DNCD = Deaths of new children (men/yr)

DDUD = AMINI(DURL,DUDD)

DDUD = Difference in unemployment as affects migration (D)
DURL = Difference between local and national unemployment rates (D)
DUDD = Difference in unemployment delayed (D)

MPAD = TABLE(TMPAD,RWI,.5,1.5,.5)

MPAD = Migrating per cent of middle aged (1/yr)
TMPAD = Table for migrating per cent of middle aged
RWI = Relative wage (D)

MPTD = TABLE(TMPTD,RWI,.5,1.5,.5)

MPTD = Migrating per cent of teenagers (1/yr)
TMPTD = Table for migrating per cent of teenagers
RWI = Relative wage (D)

MPPD = TABLE(TMPPD,RWI,.5,1.5,.5)

MPPD = Migrating per cent of prime aged (1/yr)
TMPPD = Table for migrating per cent of prime aged
RWI = Relative wage (D)

MPYD = TABLE(TMPYD,RWI,.5,1.5,.5)

MPYD = Migrating per cent of young adults (1/yr)
TMPYD = Table for migrating per cent of young adults
RWI = Relative wage (D)

MPOD = MRPOD*TMOLD

MPOD = Migrating per cent of oldsters (1/yr)
MRPOD = Migration rate, per cent of oldsters (1/yr)
TMOLD = Trend in migration of oldsters (D)

MOLD = MPOD*OLD

MOLD = Migrating oldsters (men/yr)
MPOD = Migrating per cent of oldsters (1/yr)
OLD = Oldsters, 65 and over (men)

EWD = TND+YAD+PMD+MAD

EWD = Eligible for work (men)
TND = Teenagers, ages 14 to 19 (men)
YAD = Young adults, ages 20 to 29 (men)
PMD = Prime aged, ages 30 to 44 (men)
MAD = Middle aged, ages 45 to 64 (men)

AVSD = SKLD/EWD

AVSD = Average skill (man-yrs/man)
SKLD = Total skill level (man-yrs of education)
EWD = Eligible for work (men)

ESMD = TABLE(TESMD,AVSD,8.,16.,1.)

ESMD = Effect of skill level on migration (D)
TESMD = Table of skill effect on migration
AVSD = Average skill (man-yrs/man)

MMAD = MPAD*MAD*ESMD

MMAD = Migrating Middle aged (men/yr)
MPAD = Migrating per cent of middle aged (1/yr)
MAD = Middle aged, ages 45 to 64 (men)
ESMD = Effect of skill level on migration (D)

MPMD = MPPD*PMD*ESMD

MPMD = Migrating prime aged (men/yr)
MPPD = Migrating per cent of prime aged (1/yr)
PMD = Prime ages, ages 25 to 44 (men)
ESMD = Effect of skill level on migration (D)

MYAD = MPYD*YAD*ESMD

MYAD = Migrating young adults (men/yr)
MPYD = Migrating per cent of young adults (1/yr)
YAD = Young adults, ages 20 to 29 (men)
ESMD = Effect of skill level on migration (D)

MTND = MPTD*TND*ESMD

MTND = Migrating teenagers (men/yr)
MPTD = Migrating per cent of teenagers (1/yr)
TND = Teenagers, ages 14 to 19 (men)
ESMD = Effect of skill level on migration (D)

TICD = .115*TND+.788*YAD+.801*PMD+.099*MAD

TICD = Total indicated number of children (men)
TND = Teenagers, ages 14 to 19 (men)
YAD = Young adults, ages 20 to 29 (men)
PMD = Prime ages, ages 30 to 44 (men)
MAD = Middle ages, ages 45 to 64 (men)

NMCD = .115*MTND+.788*MYAD+.801*MPMD+.099*MMAD

NMCD = Normal number of migrating children (men/yr)
MTND = Migrating teenagers (men/yr)
MYAD = Migrating young adults (men/yr)
MPMD = Migrating Prime aged (men/yr)
MMAD = Migrating middle aged (men/yr)

TRWI = TABHL(TTRWI,SLUL,.02,.16,.14)

TRWI = Target Relative wages (D)
TTRWI = Table of target relative wages
SLUL = Smoothed local unemployment rate (D)

MCHD = NMCD*CHLD/TICD

MCHD = Migrating children (men/yr)
NMCD = Normal number of migrating children (men/yr)
CHLD = Children, ages 0 to 13 (men)
TICD = Total indicated number of children (men)

NIMD = MCHD+MTND+MYAD+MPMD+MMAD+MOLD

NIMD = Net in migration (men)
MCHD = Migrating children (men/yr)
MTND = Migrating teenagers (men/yr)
MYAD = Migrating young adults (men/yr)
MPMD = Migrating prime aged (men/yr)
MMAD = Migrating middle aged (men/yr)
MOLD = Migrating oldsters (men/yr)

LSAD = BRSD*AVSD*GMAD

LSAD = Lost skills due to aging (man-yrs/yr)
BRSD = Bias factor on retirement of skills (D)
AVSD = Average skill (man-yrs/man)
GMAD = Grown middle aged (men/yr)

LSDD = AVSD*(DTND+DYAD+DPMD+DMAD)

LSDD = Lost skills due to death (man-yrs/yr)
AVSD = Average skill (man-yrs/man)
DTND = Deaths of teenagers (men/yr)
DYAD = Deaths of young adults (men/yr)
DPMD = Deaths of prime aged (men/yr)
DMAD = Deaths of middle aged (men/yr)

LSKD = LSDD+LSAD

LSKD = Lost skills (man-yrs/yr)
LSDD = Lost skills due to death (man-yrs/yr)
LSAD = Lost skills due to aging (man-yrs/yr)

ASED = ETND*TND

ASED = Added skills due to continuing education (man-yrs/yr)
ETND = Education of teenagers (man-yrs/man/yr)
TND = Teenagers, ages 14 to 19 (men)

ASCD = EGCD*GCHD

ASCD = Added skills due to children growing (man-yrs/yr)
EGCD = Education of grown children (man-yrs/man)
GCHD = Grown children (men/yr)

SMD = AVSD*BMSD

SMD = Skill of migrants (man-yrs/man)
AVSD = Average skill (man-yrs/man)
BMSD = Bias factor, migration of skill (D)

ASMD = SMD*(MTND+MYAD+MPMD+MMAD)

ASMD = Added skills due to migration (man-yrs/yr)
SMD = Skill of migrants (man-yrs/man)
MTND = Migrating teenagers (men/yr)
MYAD = Migrating young adults (men/yr)
MPMD = Migrating prime aged (men/yr)
MMAD = Migrating middle aged (men/yr)

ASKD = ASMD+ASCD+ASED

ASKD = Added skills (man-yrs/yr)
ASMD = Added skills due to migration (man-yrs/yr)
ASCD = Added skills due to children growing (man-yrs/yr)
ASED = Added skills due to continuing education (man-yrs/yr)

TCCND = WCCND+(WTCND*AMCND)+WMCND*ARCND+WLCND*RWI

TCCND = Total cost index for consumer nondurables (D)
WCCND = Weight on constant costs in consumer nondurables (D)
WTCND = Weight on transport costs in consumer nondurables (D)
AMCND = Access to market for consumer nondurables (D)
WMCND = Weight on material acquisition costs in consumer nondurables (D)
ARCND = Access to resources in consumer nondurables (D)
WLCND = Weight on labor cost in consumer nondurables (D)
RWI = Relative wage (D)

RCCND = TCCND-1.

RCCND = Relative cost of consumer nondurables (D)
TCCND = Total cost index for consumer nondurables (D)

PCCND = GLCND-CECND*RCCND

PCCND = Per cent change in consumer nondurables (1/yr)
GLCND = Growth in labor demanded for consumer nondurables (1/yr)
CECND = Cost elasticity of consumer nondurables (D)
RCCND = Relative cost of consumer nondurables (D)

CCND = PCCND*WICND

CCND = Change in consumer nondurables (men/yr)
PCCND = Per cent change in consumer nondurable (1/yr)
WICND = Workers in nondurable fabrication (men)

TCHFB = WCHFB+WTHFB*AMHFB+WLHFB*RWI

TCHFB = Total cost index for household fabricating (D)
WCHFB = Weight on constant cost in household fabricating (D)
WTHFB = Weight on transportation cost in household fabricating (D)
AMHFB = Access to market for household fabricating (D)
WLHFB = Weight on labor cost for household fabricating (D)
RWI = Relative wage (D)

RCHFB = TCHFB-1.

RCHFB = Relative cost of household fabricating (D)
TCHFB = Total cost index of household fabricating (D)

PCHFB = GLHFB-CEHFB*RCHFB

PCHFB = Per cent change in household fabricating (1/yr)
GLHFB = Growth in labor demanded for household fabricating (1/yr)
CEHFB = Cost elasticity of household fabricating (D)
RCHFB = Relative cost of household fabricating (D)

CHFB = PCHFB*WIHFB

CHFB = Change in household fabricating (men/yr)
PCHFB = Per cent change in nondurable (1/yr)
WIHFB = Workers in household fabricating (men)

TCROP = WCROP+WTROP*AMROP+WMROP*ARROP+WLROP*RWI

TCROP = Total cost index for resource oriented processing (D)
WCROP = Weight on constant costs in resource oriented processing (D)
WTROP = Weight on transport costs in resource oriented processing (D)
AMROP = Access to markets in resource oriented processing (D)
WMROP = Weight on material acquisition costs in resource oriented processing (D)
ARROP = Access to resources in resource oriented processing (D)
WLROP = Weight on labor costs in resources oriented processing (D)
RWI = Relative wage (D)

RCROP = TCROP-1.

RCROP = Relative cost of resource oriented processing (D)
TCROP = Total cost index of resource oriented processing (D)

PCROP = GLROP-CEROP*RCROP

PCROP = Per cent change in resource oriented processing (1/yr)
GLROP = Growth in labor demanded for resource oriented processing (1/yr)
CEROP = Cost elasticity of resource oriented processing (D)
RCROP = Relative cost resource oriented processing (D)

CROP = PCROP*WIROP

CROP = Change in resource oriented processors (men/yr)
PCROP = Per cent change in resource oriented processing (1/yr)
WIROP = Workers in resource oriented processing (men)

TCPRM = WCPRM+WTPRM*AMPRM+WMPRM*ARPRM+WLPRM*RWI

TCPRM = Total cost index for primary metals (D)
WCPRM = Weight on constant costs in primary metals (D)
WTPRM = Weight on transport costs in primary metals (D)
AMPRM = Access to markets for primary metals (D)
WMPRM = Weight on material acquisition costs for primary metals (D)
ARPRM = Access to resources for primary metals (D)
WLPRM = Weight on labor costs for primary metals (D)
RWI = Relative wage (D)

RCPRM = TCPRM-1.

RCPRM = Relative cost of primary metals (D)
TCPRM = Total cost index of primary metals (D)

PCPRM = GLPRM-CEPRM*RCPRM

PCPRM = Per cent change in primary metals (1/yr)
GLPRM = Growth in labor demanded for primary metals (1/yr)
CEPRM = Cost elasticity of primary metals (D)
RCPRM = Relative cost of primary metals (D)

CPRM = PCPRM*WIPRM

CPRM = Change in primary metals (men/yr)
PCPRM = Per cent change in primary metals (1/yr)
WIPRM = Workers in primary metals (men)

TCEMF = WCEMF+WTEMF*AMEMF+WLEMF*RWI

TCEMF = Total cost index for export manufacturing (D)
WCEMF = Weight on constant costs in export manufacturing (D)
WTEMF = Weight on transport costs in export manufacturing (D)
AMEMF = Access to markets for export manufacturing (D)
WLEMF = Weight on labor costs for export manufacturing (D)
RWI = Relative wage (D)

RCEMF = TCEMF-1.

RCEMF = Relative cost of export manufacturing (D)
TCEMF = Total cost index for export manufacturing (D)

PCEMF = GLEMF-CEEMF*RCEMF

PCEMF = Per cent change in export manufacturing (1/yr)
GLEMF = Growth in labor demanded in export manufacturing (1/yr)
CEEMF = Cost elasticity of export manufacturing (D)
RCEMF = Relative cost of export manufacturing (D)

CEMF = PCEMF*WIEMF

CEMF = Change in export manufacturing (men/yr)
PCEMF = Per cent change in export manufacturing (1/yr)
WIEMF = Workers in export manufacturing (men)

TCCHM = WCCHM+WTCHM*AMCHM+WMCHM*ARCHM+WLCHM*RWI

TCCHM = Total cost index for chemicals (D)
WCCHM = Weight on constant costs for chemicals (D)
WTCHM = Weight on transport costs for chemicals (D)
AMCHM = Access to markets for chemicals (D)
WMCHM = Weight on material acquisition costs for chemicals (D)
ARCHM = Access to resources for chemicals (D)
WLCHM = Weight on labor costs for chemicals (D)
RWI = Relative wages (D)

RCCHM = TCCHM-1.

RCCHM = Relative cost of chemicals (D)
TCCHM = Total cost index for chemicals (D)

PCCHM = GLCHM-CECHM*RCCHM

PCCHM = Per cent change in chemicals (D)
GLCHM = Growth in labor demanded for chemicals (1/yr)
CECHM = Cost elasticity of chemicals (D)
RCCHM = Relative cost of chemicals (D)

CCHM = PCCHM*WICHM

CCHM = Change in chemicals (men/yr)
PCCHM = Per cent change in chemicals (1/yr)
WICHM = Workers in chemicals (men)

DABI = DWBI-WBSI-IBBI

DABI = Desired additional workers in business serving industries (men)
DWBI = Desired workers in business serving industries (men)
WBSI = Workers in business serving industries (men)
IBBI = Initial bias in desired workers in business serving industries (men)

DBGI = TABLE(TDBGI,DABI,-1.E5,1.E5,1.E5)

DBGI = Desired business serving industry growth rate (men/yr)
TDBGI= Table of desired business serving industry growth rate
DABI = Desired additional workers in business serving industries (men)

LAMI = TABHL(TLAMI,LURL,.0,.1,.05)

LAMI = Labor availability multiplier (D)
TLAMI = Table labor availability multiplier
LURL = Local unemployment rate (D)

BSGI = LAMI*DBGI

BSGI = Business serving industry growth rate (men/yr)
LAMI = Labor availability multiplier (D)
DBGI = Desired business serving industry growth rate (men/yr)

DAHI = DWHI-WHSI-IBHI

DAHI = Desired additional workers in household serving industries (men)
DWHI = Desired workers in household serving industries (men)
WHSI = Workers in household serving industries (men)
IBHI = Initial bias in desired workers in household serving industries (men)

DHGI = TABLE(TDHGI,DAHI,-1.E5,1.E5,1.E5)

DHGI = Desired household serving industry growth rate (men/yr)
TDHGI = Table of desired household serving industry growth rate
DAHI = Desired additional workers in household serving industries (men)

HSGI = LAMI*DHGI

HSGI = Household serving industry growth rate (men/yr)
LAMI = Labor availability multiplier (D)
DHGI = Desired household serving industry growth rate (men/yr)

CWA = PCWA*WA

CWA = Change of workers in agriculture (men)
PCWA = Per cent change of workers in agriculture (1/yr)
WA = Workers in agriculture (men)

CHLD = CHLD+DT*(BCHD+MCHD-GCHD-DCHD)

CHLD = Children, ages 0 to 13 (men)
DT = Time between the current time period and the one preceding
BCHD = Births of children (men/yr)
MCHD = Migrating children (men/yr)
GCHD = Grown children (men/yr)
DCHD = Deaths of children (men/yr)

TND = TND+DT*(GCHD+MTND-GTND-DTND)

TND = Teenagers, ages 14 to 19 (men)
DT = Time between the current time period and the one preceding
GCHD = Grown children (men/yr)
MTND = Migrating teenagers (men/yr)
GTND = Grown teenagers (men/yr)
DTND = Deaths of teenagers (men/yr)

YAD = YAD+DT*(GTND+MYAD-GYAD-DYAD)

YAD = Young adults, ages 20 to 29 (men)
DT = Time between the current time period and the one preceding
GTND = Grown teenagers (men/yr)
MYAD = Migrating young adults (men/yr)
GYAD = Grown young adults (men/yr)
DYAD = Deaths of young adults (men/yr)

PMD = PMD+DT*(GYAD+MPMD-GPMD-DPMD)

PMD = Prime ages, ages 30 to 44 (men)
DT = Time between the current time period and the one preceding
GYAD = Grown young adults (men/yr)
MPMD = Migrating prime aged (men/yr)
GPMD = Grown prime aged (men/yr)
DPMD = Deaths of prime aged (men/yr)

MAD = MAD+DT*(GPMD+MMAD-GMAD-DMAD)

MAD = Middle ages, ages 45 to 64 (men)
DT = Time between the current time period and the one preceding
GPMD = Grown prime aged (men/yr)
MMAD = Migrating middle aged (men/yr)
GMAD = Grown middle aged (men/yr)
DMAD = Deaths of middle aged (men/yr)

OLD = OLD+DT*(GMAD+MOLD-DOLD)

OLD = Oldsters, ages 65 and over (men)
DT = Time between the current time period and the one preceding
GMAD = Grown middle aged (men/yr)
MOLD = Migrating oldsters (men/yr)
DOLD = Deaths of oldsters (men/yr)

DUDD = DUDD+DT*(DURL-DUDD)/DEDUD

DUDD = Difference in unemployment delayed (D)
DT = Time between the current time period and the one preceding
DURL = Difference between local and national unemployment rates (D)
DEDUD = Delay in effect of difference in unemployment (yrs)

SKLD = SKLD+DT*(ASKD-LSKD)

SKLD = Total skill level (man-yrs of education)
DT = Time between the current time period and the one preceding
ASKD = Added skills (man-yrs/yr)
LSKD = Lost skills (man-yrs/yr)

SLUL = SLUL+DT*(LURL-SLUL)/DSLUL

SLUL = Smoothed local unemployment rate (D)
DT = Time between the current time period and the one preceding
LURL = Local unemployment rate (D)
DSLUL = Delay in smoothing local unemployment rate (yr)

RWI = RWI+DT*(TRWI-RWI)/DRWI

RWI = Relative wage (D)
DT = Time between the current time period and the one preceding
TRWI = Target relative wage (D)
DRWI = Delay in relative wage (D)

WICND = WICND+DT*CCND

WICND = Workers in consumer nondurables (men)
DT = Time between the current time period and the one preceding
CCND = Change in consumer nondurables (men/yr)

WIHFB = WIHFB+DT*CHFB

WIHFB = Workers in household fabricating (men)
DT = Time between the current time period and the one preceding
CHFB = Change in household fabricating (men/yr)

WIROP = WIROP+DT*CROP

WIROP = Workers in resource oriented processing (men)
DT = Time between the current time period and the one preceding
CROP = Change in resource oriented processing (men/yr)

WIPRM = WIPRM+DT*CPRM

WIPRM = Workers in primary metals (men)
DT = Time between current time period and the one preceding
CPRM = Change in primary metals (men/yr)

WIEMF = WIEMF+DT*CEMF

WIEMF = Workers in export manufacturing (men)
DT = Time between current time period and the one preceding
CEMF = Change in export manufacturing (men/yr)

WICHM = WICHM+DT*CCHM

WICHM = Workers in chemicals (men)
DT = Time between current time period and the one preceding
CCHM = Change in chemicals (men/yr)

WBSI = WBSI+DT*BSGI

WBSI = Workers in business serving industries (men)
DT = Time between current time period and the one preceding
BSGI = Business serving industry growth rate (men/yr)

IBBI = IBBI-DT*IBBI/TCIBI

IBBI = Initial bias in desired workers in business serving industry (men)
DT = Time between current time period and the one preceding
TCIBI = Time constant of initial bias (yr)

WHSI = WHSI+DT*HSGI

WHSI = Workers in household serving industries (men)
DT = Time between current time period and the one preceding
HSGI = Household serving industry growth rate (men/yr)

IBHI = IBHI-DT*IBHI/TCIBI

IBHI = Initial bias in desired workers in household serving industries (men)
DT = Time between current time period and the one preceding
TCIBI = Time constant of initial bias (yr)

WA = WA+DT*CWA

WA = Workers in agriculture (men)
DT = Time between current time period and the one preceding
CWA = Change in workers in agriculture (men/yr)

SNURL = SNURL+DT/DSNUL*(NURL-SNURL)

SNURL = Smoothed national unemployment rate
DT = Time between current time period and the one preceding
DSNUL = Delay in smoothing national unemployment rate (yr)
NURL = National unemployment rate (D)

APPENDIX B

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